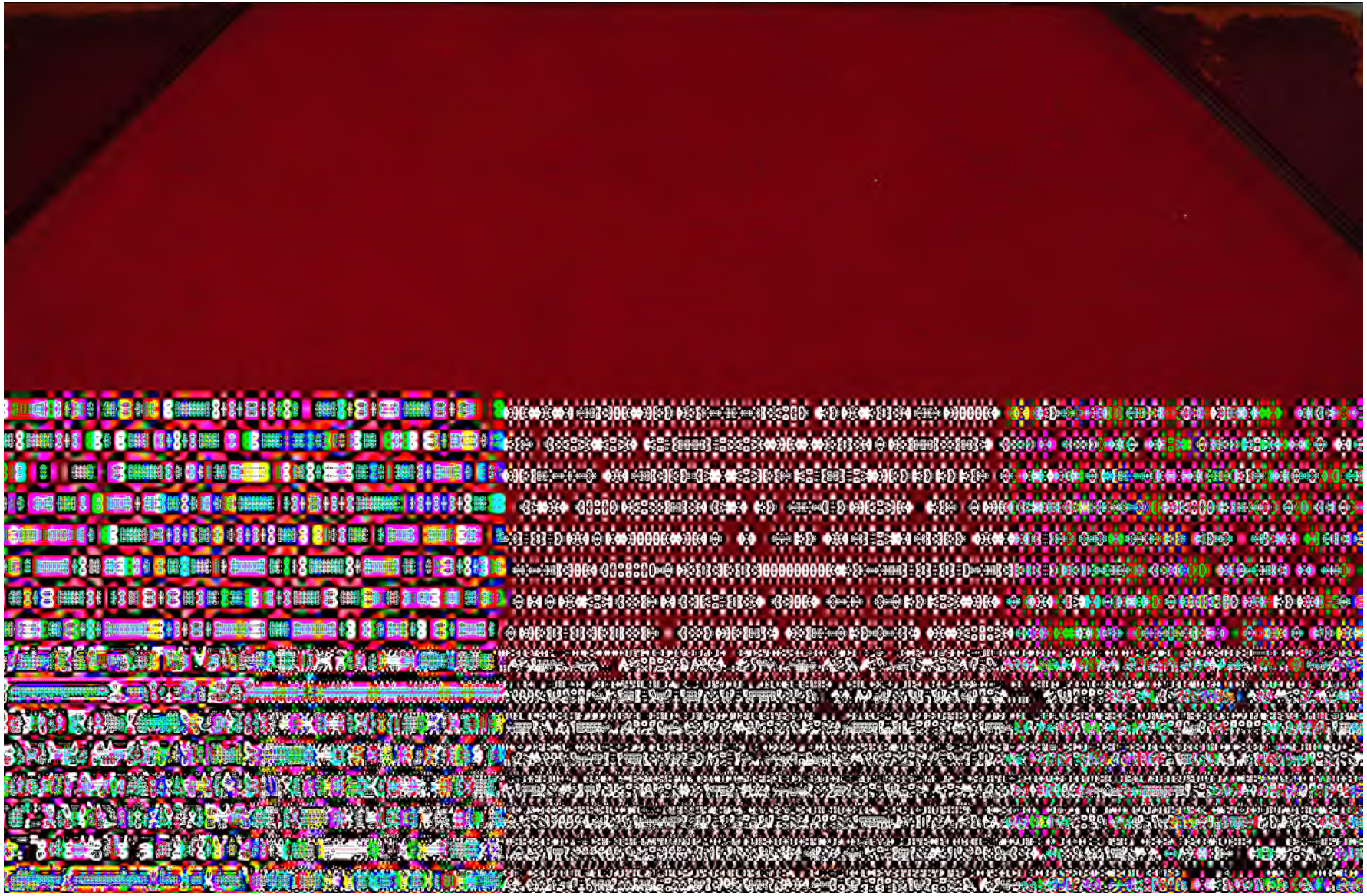

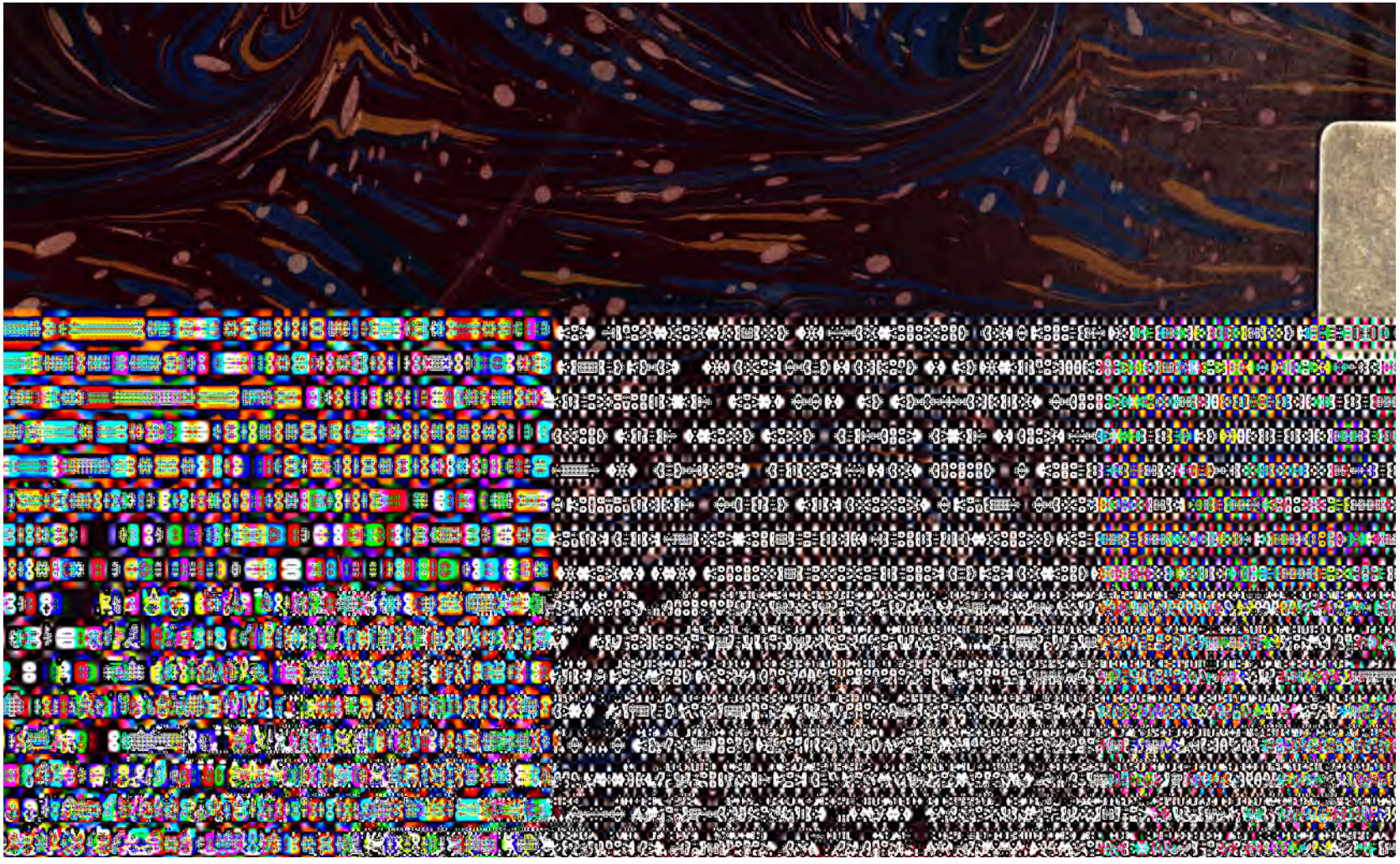

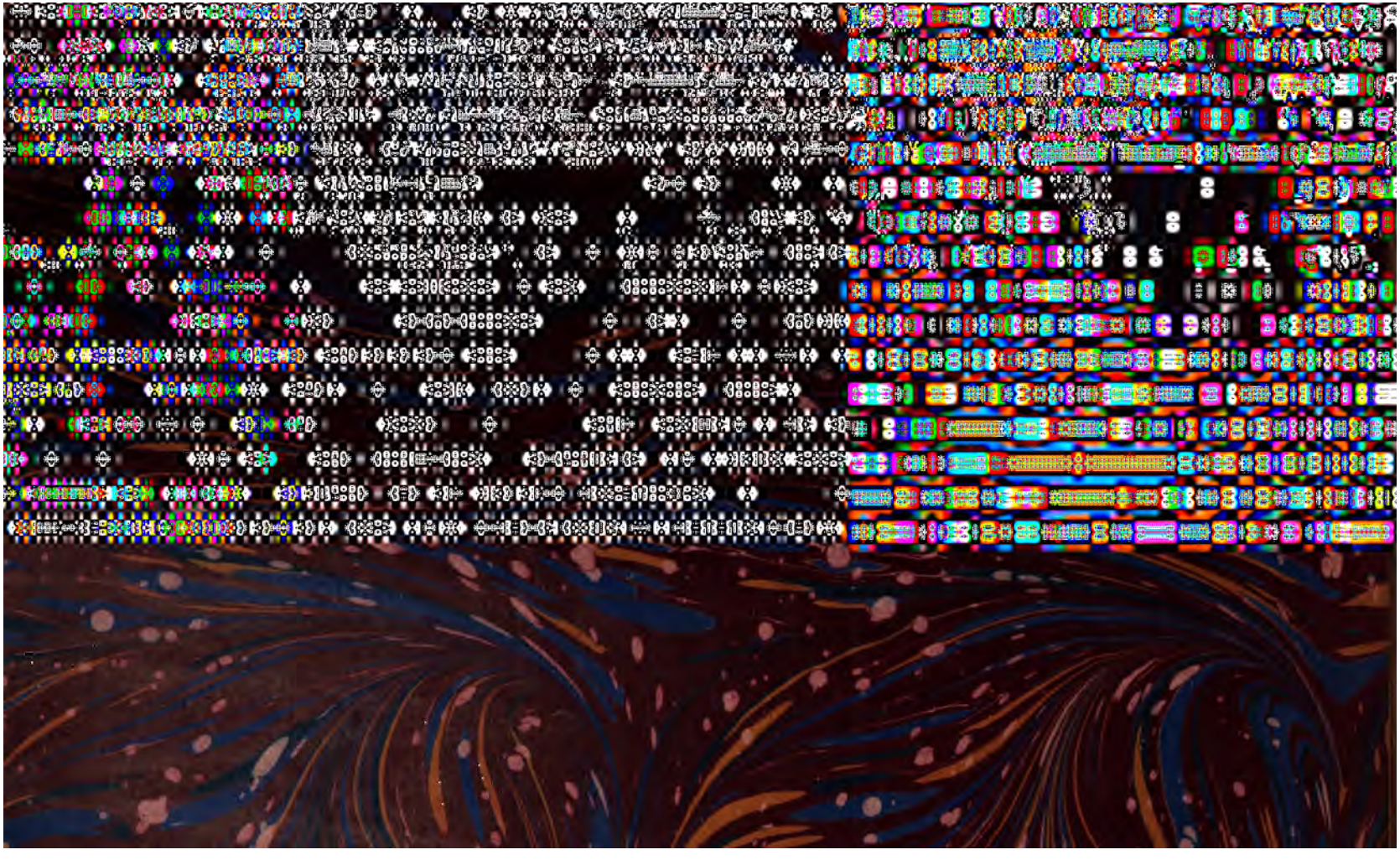

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THE TERRITORIES.

F. V. HAYDEN,
U. S. GEOLOGIST-IN-CHARGE.

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PREFATORY NOTE.

Bulletin No. 4 completes Volume II of the series, for the year 1876. That much new and valuable matter to science has been issued in the two volumes will, I think, be admitted. Whether the Bulletin will be continued hereafter will depend on circumstances which cannot now be foreseen. A third volume may be commenced during the coming winter when the field work of the Survey is closed for the season. I beg to convey my cordial thanks to the collaborators of the Survey, who have furnished most valuable articles; also, to Dr. A. C. Peale, for the preparation of the index.

F. V. HAYDEN,
United States Geologist.

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BULLETIN No. 3.

A NOTICE OF THE ANCIENT RUINS OF SOUTHWESTERN COLORADO, EXAMINED DURING THE SUMMER OF 1875.

By W. H. Holmes.

In addition to my duties as geologist to the southwest or San Juan division of the survey for 1875, I was assigned the very agreeable task of making examinations of such ancient remains as might be included in the district surveyed.

Much information had already been given to the public in relation to the ruins of Southwestern Colorado by Mr. Jackson, who paid them a short visit in 1874, and many similar remains had been described by early explorers in New Mexico and Arizona, but nothing like a complete survey of this particular region had been made.

The district examined by our party covers an area of nearly 6,000 square miles, chiefly in Colorado, but including narrow belts in the adjacent Territories of New Mexico, Utah, and Arizona. It lies wholly on the Pacific slope, and belongs almost entirely to the drainage-system of the Rio San Juan, a tributary of the Colorado of the West.

Lying along the west base of the mountains is a comparatively flat country, the eastern border of the great plateau-region that reaches westward toward the Sierras. The surface-geology is chiefly Cretaceous, and the various large streams formed on the west slope of the Rocky Mountains have cut long cañoned valleys down through the nearly horizontal beds. In the greater part of this region, there is little moisture apart from these streams, and, as a consequence, vegetation is very sparse, and the general aspect of the country is that of a semi-desert. Yet there is bountiful evidence that at one time it supported a numerous population; there is scarcely a square mile in the 6,000 examined that would not furnish evidence of occupation by a race totally distinct from the nomadic savages who hold it now, and in every way superior to them.

At first, it seems strange that a country so dry and apparently barren could support even a moderate population, and it is consequently argued that the climate has grown less moist since the ancient occupation. Be this as it may, I observe the fact that the great bulk of remains are on, or in the immediate neighborhood of running streams, or by springs that furnish a plentiful supply of water during the greater part of the year. The ever-present pottery may in many cases have been broken and left by hunting and wandering parties, and the remnants of dwellings far out from water may be but temporary abodes used only in the winter or during rainy seasons.

I also notice that the country is by no means an entire desert. All along the stream-courses, there are grass-covered meadows and broad belts of alluvial bottom, affording, if properly utilized, a considerable area of rich tillable land.

The ruins of this region, like most others of the extreme West and South, are the remnants in a great measure of stone structures. To

what extent wood and adobe were used can hardly be determined. It is evident, however, that the greater portion of the villages and dwellings of the lowlands have been of material other than stone, frequently doubtless of rubble and adobe combined.

As to situation, they may be classified very properly under three heads: (1) lowland or agricultural settlements; (2) cave-dwellings; and (3) cliff-houses or fortresses.

Those of the first class are chiefly on the river-bottoms, in close proximity to water, in the very midst of the most fertile lands, and located without reference to security or means of defense.

Those of the second are in the vicinity of agricultural lands, but built in excavations in low-bluff faces of the Middle Cretaceous shales. The sites are chosen also, I imagine, with reference to security; while the situation of the cliff-houses is chosen totally with reference to security and defense, built high up in the steep and inaccessible cliffs, and having the least possible degree of convenience to field or water.

As to use, the position for the most part determines that. The lowland ruins are the remains of agricultural settlements, built and occupied much as similar villages and dwellings would be occupied by peaceable and unmolested peoples of to-day. The cave-dwellers, although they may have been of the same tribe and contemporaneous, probably built with reference to their peaceable occupations as well as to defense, and it is impossible to say whether or not they made these houses their constant dwelling-places. The cliff-houses could only have been used as places of refuge and defense. During seasons of invasion and war, families were probably sent to them for security, while the warriors defended their property or went forth to battle; and one can readily imagine that when the hour of total defeat came, they served as a last resort for a desperate and disheartened people.

In form, the parallelogram and circle predominate, and a considerable degree of architectural skill is displayed. Where the conformation of the ground permits, the squares are *perfect* squares and the circles *perfect* circles. A greater part of the ordinary structures are square or rectangular; while attached to each group, and sometimes without indications of contiguous buildings, are the circular ruins frequently resembling towers. These are the most pretentious structures, being often as much as forty feet in diameter, and in many cases having double or triple walls. They are solidly built of hewn stone, dressed on the outside to the curve, neatly jointed, and laid in mortar.

The space between the outer walls is invariably divided by heavy partition-walls into a number of apartments, while a circular depression, or *estufa** occupies the center of the inclosure.

It seems evident, from the extraordinary form of these structures and the unusual care shown in their construction, that they were not designed for the ordinary uses of dwelling or defense. It has been observed that, among nearly all the ancient tribes of North America, the grandest and most elaborate works of art were the offspring of their superstitions, and it does not seem at all improbable that these great towers had a religious origin.

It is stated that the eternal fire—an essential of their worship—has always been kept in circular inclosures, and that the circle symbolizes the sun, their deity. The occurrence, therefore, of one or more of these circular inclosures in each of their settlements can be rationally accounted for; but it is with less certainty we arrive at conclusions in regard to the triple walls and the cell-like apartments. In the inhabited

*A Spanish word signifying "sweat-house" or council-house.

pueblos of to-day, there are underground rooms, mostly circular, used as council-chambers as well as for the performance of the mysterious rites of their religion. Similar chambers occur, according to Lieutenant Simpson, in all the ruined cities of New Mexico, but having single walls of no great height or thickness. It is stated by Squier and Davis* that in Mexico the sacred inclosures were also used for defensive purposes, and it certainly seems probable that these curious structures served the double purpose of temples and fortifications, and that the apartments between the walls were the cells of the priesthood or the receptacles of sacred or valuable property.

The smaller single-walled towers, which are scattered at intervals along the river-courses and cañons, frequently in commanding situations, were probably watch or signal towers.

The cave-dwellings are made by digging irregular cavities in the faces of bluffs and cliffs formed of friable rock, and then walling up the front, leaving only a small doorway for entrance and an occasional small window at the side or top.

The cliff-houses conform in shape to the floor of the niche or shelf on which they are built. They are of firm neat masonry, and the manner in which they are attached or cemented to the cliffs is simply marvelous. Their construction has cost a great deal of labor, the rock and mortar of which they are built having been brought for hundreds of feet up the most precipitous places. They have a much more modern look than the valley and cave remains, and are probably in general more recent, belonging rather to the close than to the earlier parts of a long period of occupation. Their position, however, has secured them in a great measure from the hand of the invader as well as from the ordinary effects of age.

Of works of art other than architectural that might assist in throwing light upon the grade of civilization reached by these people, but meager discoveries were made; although I imagine that careful search and well-conducted exhumation might develop many things of great interest. A small number of arrow-heads, stone-implements, ornaments, and articles of fictile manufacture, that may fairly be attributed to the age of the cliff-builders, were collected. The greater part of these are figured in plates XIII and XIV. There are no evidences whatever that metals were used.

Numerous hieroglyphics were observed, both engraved and painted upon the cliffs. Drawings of a large number were made, and some of the more notable examples are given in plates XI and XII.

A great number of burial-places were noted, but of the graves examined few yielded farther evidences of occupation than small quantities of charcoal and bits of painted pottery. These burial-places, which are in a number of cases covered by a heavy growth of full-grown piñon pines and cedars, are usually found on the summits of high ridges and promontories, and are still marked by slabs of sandstone set on edge and arranged in circles, and parallelograms of greatly-varying dimensions. But that they did not always bury their dead in high places is proven by the frequent discovery of human remains in the arroyos or deep washes in the valleys. Three skeletons were obtained, in the vicinity of ruined villages, from the sides of recent washes.

The accompanying plates are, with one exception, reproductions of pen-drawings, and are arranged for convenience, rather than from any method of classification. The plans are not drawn to a uniform scale, because of the inconvenience of such an arrangement; but measure

* Ancient Monuments of the Mississippi Valley, page 102.

ments are so frequently given on the plates themselves that no confusion need occur. Measurements were taken by tape-line in all the more important structures; but in many of the ordinary ruins, where exact dimensions were not considered essential, the distances were estimated. It is to be greatly regretted that extreme haste frequently prevented close and accurate work.

The accompanying map will give the location of all the more important groups of ruins.

The fragments of information collected in this notice are given with the hope that they may throw a little additional light upon the very interesting problems of ancient American history.

RUINED VILLAGE ON THE RIO LA PLATA.

Plate I.

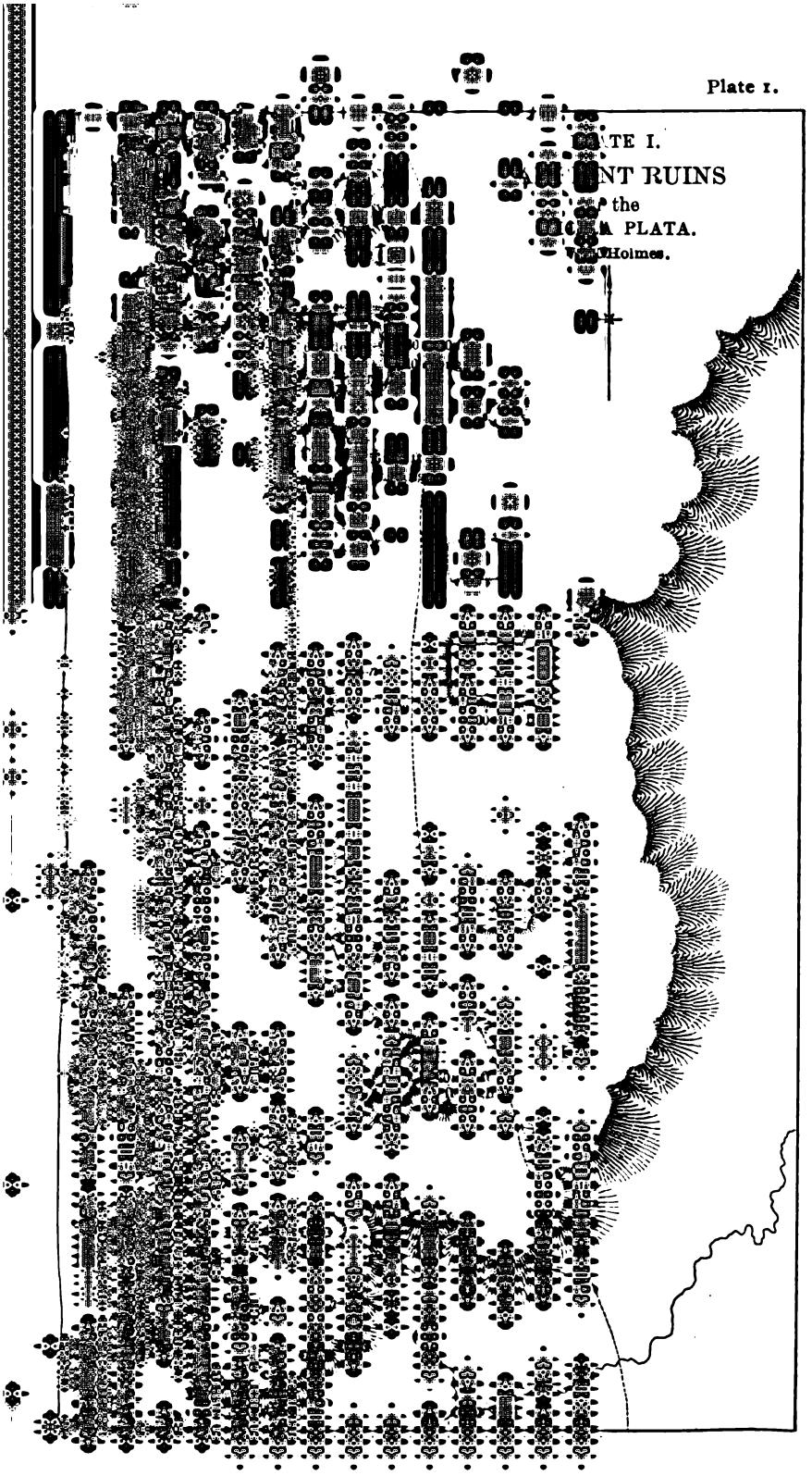
The first group of ruins observed is situated on the Rio La Plata, about twenty-five miles above its junction with the San Juan, and three or four miles south of the New Mexican line. It is doubtless the remains of a large irregular village, and stands on a low terrace, some 20 feet above the river-bed, and near the center of a large fertile valley.

It will be seen, by reference to the plate, which includes only the more important part of the town, that the buildings have been isolated, and, in a measure, independent of each other, differing in this respect from most of the groups of ruins farther south.

The forms are chiefly rectangles and circles; one or two seem to have been elliptical, while a number have consisted of irregular groups or clusters of apartments. All that now remains to mark the site of these ancient structures is the low, rounded heaps and lines of *débris*, composed of earth, water-worn pebbles, and small fragments of sandstone. The walls of four of the main structures are quite distinctly marked. That of the circle *c* is still 4 feet high on the outside, and incloses a depression, probably an *estufa*, which, in the center, is 2 or 3 feet below the terrace-level.

North of this, about 300 feet, is a truncated rectangular mound, 9 or 10 feet in height and 50 feet in width by 80 in length. On the east end, near one of the angles, is a low, projecting pile of *débris* that may have been a tower. There is nothing whatever to indicate the use of this structure. Its flat top and height give it more the appearance of one of the sacrificial mounds of the Ohio Valley than any other observed in this part of the West. It may have been, however, only a raised foundation, designed to support a superstructure of wood or adobe.

North of this again, and 100 feet distant, is a rectangular inclosure about 60 by 100 feet. It is slightly excavated in the center, and the rounded and irregular wall is from 4 to 6 feet in height. The space between this and the last-mentioned structure is filled in to the depth of 2 or 3 feet, and the amount of *débris* about their bases indicates original walls of considerable height. North of this are scattered a number of inferior ruins, the walls of which are not always distinctly marked. These extend back toward a row of low hills, the remnants of a superior terrace, on the summits of which a number of artificial depressions were found. Such "dug holes" are generally quite numerous in the vicinity of these ruins, and have doubtless in many cases been made by throwing up earthworks for defensive purposes. South of the large circle is a mass of ruins covering some 15,000 square feet, but so much reduced that nothing further could be determined than the fact that it had contained a large number of irregular apartments. Next to this is a rect-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Holmes.

angular ruin, containing three well-marked apartments. Its walls are 6 or 7 feet high, and, unlike those of the preceding examples, do not coincide with the cardinal points. South of this, and occupying the extreme southern end of the terrace, are a number of small circles and mounds, while an undetermined number of diminutive mounds are distributed among the other ruins.

To the east of the Indian trail, as shown in the plate, are a number of inclosures of lesser importance, which, from want of time, were not closely examined.

Nowhere about these ruins are there any considerable indications of defensive works, and the village, which is scattered over an area fully two miles in circuit, has no natural advantages whatever. Neither are there traces of ditches, nor of anything that might throw important light upon the habits or occupations of the people. A few arrow-heads and minute cutting-implements were picked up. Countless chips of jasper, obsidian, and flint were scattered around, and the soil was literally full of fragments of painted and ornamented pottery.

On the opposite side of the river, and at intervals above and below, are isolated groups of ruins and heaps of *débris*—certainly the remains of dwellings. These seem to have been distributed very much as dwelling-houses would be in the rural districts of civilized and peaceable communities.

It is possible that there are undiscovered ruins on this stream equally important with that described; for, in pursuing my geologic investigations, I was compelled to take a long detour to the westward from this point, returning to the La Plata again a few miles above its junction with the San Juan. On this occasion, while riding through a desert-like locality, quite naked and barren, much resembling the well-known *Mauvaises terres*, I was surprised to observe fragments of pottery strewn around, and presently a number of ruins, in a very reduced state and almost covered by the drifting sand, and this six or eight miles from water. On the high, dry table-lands, on all sides, fragments of pottery were picked up. What could have induced people to build and dwell in such a locality it is useless to surmise.

GROUP OF CAVE-DWELLINGS AND TOWERS ON THE RIO SAN JUAN.

Plate II.

On the San Juan River, about thirty-five miles below the mouth of the La Plata and ten miles above the Mancos, occurs the group of ruins figured in Plate II.

The river is bordered here by low lines of bluffs formed from the more compact portions of the Middle Cretaceous shales. At this particular place, the vertical-bluff face is from 35 to 40 feet in height.

I observed, in approaching from above, that a ruined tower stood near the brink of the cliff, at a point where it curves outward toward the river, and in studying it with my glass detected a number of cave-like openings in the cliff-face about half-way up. On examination, I found them to have been shaped by the hand of man, but so weathered out and changed by the slow process of atmospheric erosion that the evidences of art were almost obliterated.

The openings are arched irregularly above, and generally quite shallow, being governed very much in contour and depth by the quality of the rock. The work of excavation has not been an extremely great

one, even with the imperfect implements that must have been used, as the shale is for the most part soft and friable.

A hard stratum served as a floor, and projecting in many places made a narrow platform by which the inhabitants were enabled to pass along from one house to another.

Small fragments of mortar still adhered to the firmer parts of the walls, from which it is inferred that they were at one time plastered. It is also extremely probable that they were walled up in front and furnished with doors and windows, yet no fragment of wall has been preserved. Indeed, so great has been the erosion that many of the caves have been almost obliterated, and are now not deep enough to give shelter to a bird or bat.

This circumstance should be considered in reference to its bearing upon the question of antiquity. If we suppose the recess to be destroyed is six feet deep, the entire cliff must recede that number of feet in order to accomplish it. If the rock were all of the friable quality of the middle part, this would indeed be the matter of a very few decades; but it should be remembered that the upper third of the cliff-face is composed of beds of comparatively hard rocks, sandstones, and indurated shal s. It should also be noted still further that at the base of the cliff there is an almost total absence of *débris*, or fallen rock, or even of an ordinary talus of earth, so that the period that has elapsed since these houses were deserted must equal the time taken to undermine and break down the six feet of solid rock, plus the time required to reduce this mass of rock to dust; considering also that the erosive agents are here unusually weak, the resulting period would certainly not be inconsiderable.

Figure 2 gives a fair representation of the present appearance of these dwellings, while their relations to the group of ruins above will be understood by reference to figure 1. These ruins are three in number—one rectangular and two circular. The rectangular one, as indicated in the plan C, is placed on the edge of the mesa, over the more northern group of cave-dwellings; it is not of great importance, being only 34 by 40 feet, and scarcely 2 feet high; the walls are 1½ feet thick, and built of stone.

The small tower B is situated on the brink of the cliff, directly above one of the principal groups of cave-houses. It is neatly built of stone, which, although not hewn, is so carefully chosen and adjusted to the curve that the wall is quite regular. That the stone was procured from the neighboring cliffs is indicated by the presence of great numbers of characteristic fossils. The wall is 18 inches thick and from 2 to 6 feet in height.

Long lines of *débris*, radiating from all sides, indicate that it has been much higher, and has but recently fallen. This tower is inclosed by a wall, also circular in form, but open toward the cliff, as seen in the drawing; the ends projecting forward and irregular and broken as if portions had fallen. Its construction is like that of the inner wall, but the height is not more than 3 feet at any point. The diameter of the inner circle is 12 feet, that of the outer 22 feet; the distance, therefore, between the walls is a little less than 4 feet. In this space, there are indications of partition-walls that have originally divided it into a number of apartments.

About one hundred and fifty yards to the southwest of this ruin are the remains of another similar structure. It has been, however, on a much grander scale. The walls are 26 inches thick, and indicate a diameter in the outer wall of about 140 feet. They are not above 4 feet high at any point, and in the parts toward the cliff can only be traced

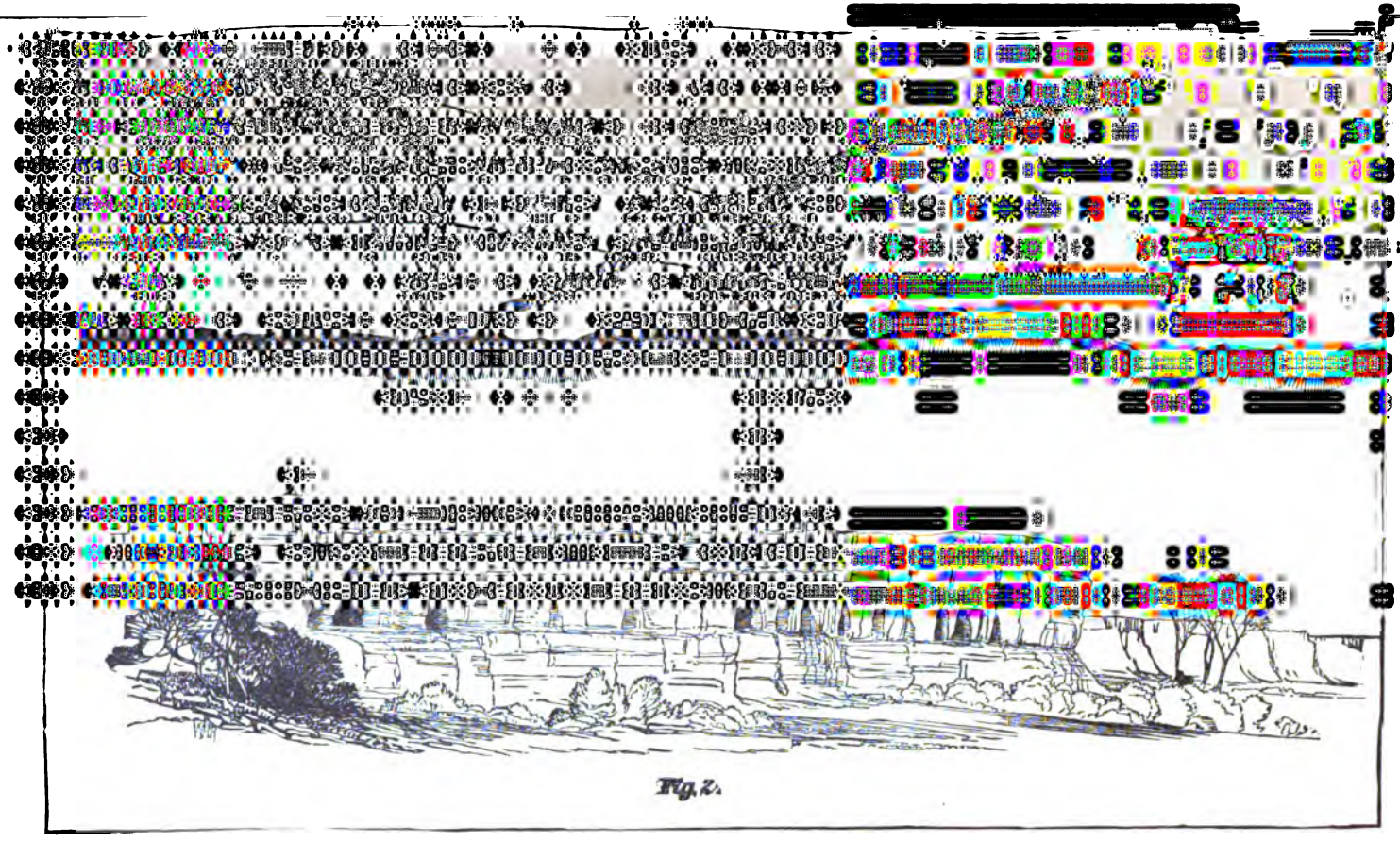
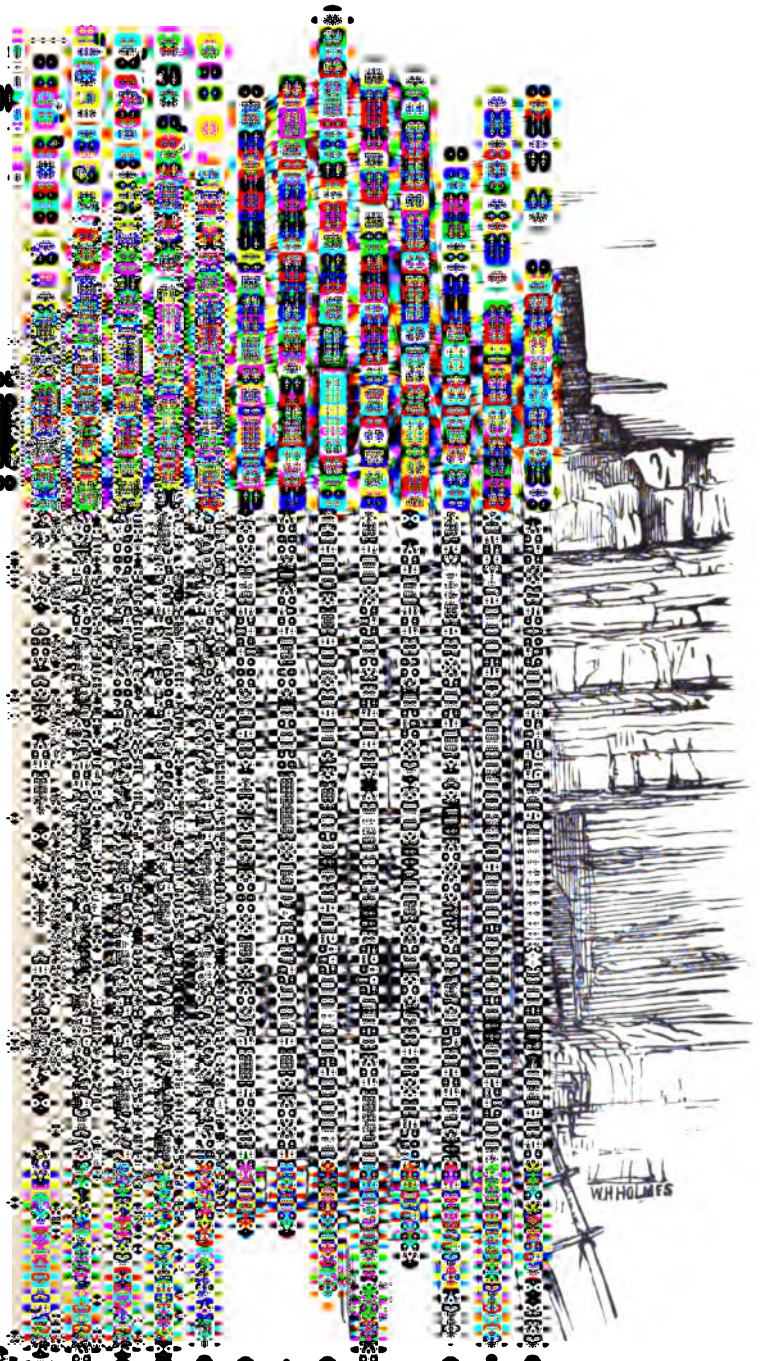


Fig. 2.

Plate 2.

Plate 3.



by a low ridge of earth. The remaining fragments of wall are at the remoter parts of the circles, and are in every respect like the walls already described. The inner wall, which can be traced but a short distance, is 8½ feet from the outer, and has been connected by partition-walls, as in the other case.

The first impression given by this curious inclosure is that it was designed for a "corral", and used for the protection of herds of domestic animals; but since these people are not known to have possessed domestic animals, and when we further consider that inclosures of pickets would have served this purpose as well as such a massive and extraordinary structure, we can hardly avoid assigning it to some other use, which use, doubtless similar to that of the smaller tower, is very naturally suggested by its location and construction.

That they both belonged to the community of cave-dwellers, and served as their fortresses, council-chambers, and places of worship, would seem to be natural and reasonable inferences. Being on the border of a low mesa country that rises toward the north, the strong outside walls were doubtless found necessary to prevent incursions from that direction, while the little community by means of ladders would be free to pass from dwelling to temple and fortress without danger of molestation.

The original height of these structures must necessarily be a matter of conjecture, and it is true that although there is every evidence of age, both in the cave-dwellings and in the walled inclosures above, the lack of great quantities of crumbling walls and *débris*, and the general bareness of the ruins, give rise to the notion that they were but meager affairs. If we conclude, however, that the outer walls were constructed for defense, and their thickness and form favor such a hypothesis, their height would probably have been as great as fifteen or twenty feet, while the inner walls, being equally heavy and well built, would be sufficiently high to accommodate two or three stories. With these conclusions in view, I have ventured to present a sketch showing a restoration of the smaller tower (plate III). This sketch illustrates the probable appearance of the dwellings and tower, and the supposed means of communication between them.

The manner of walling up the fronts of the cave-dwellings, as here given, was observed frequently on the Rio Mancos, where, in corresponding cliffs of shaly sandstones, there are many well-preserved specimens. A large group situated on this stream, about ten miles above its mouth, was subsequently examined. The walls were in many places quite well preserved and new-looking, while all about, high and low, were others in all stages of decay. In one place in particular, a picturesque outstanding promontory has been full of dwellings, literally honeycombed by this earth-burrowing race, and as one from below views the ragged, window-pierced crags, he is unconsciously led to wonder if they are not the ruins of some ancient castle, behind whose moldering walls are hidden the dread secrets of a long-forgotten people; but a nearer approach quickly dispels such fancies, for the windows prove to be only the doorways to shallow and irregular apartments, hardly sufficiently commodious for a race of pigmies. Neither the outer openings nor the apertures that communicate between the caves are large enough to allow a person of large stature to pass, and one is led to suspect that these nests were not the dwellings proper of these people, but occasional resorts for women and children, and that the somewhat extensive ruins in the valley below were their ordinary dwelling-places. On the brink of the promontory above stands the ruin of a tower, still twelve feet high, and similar in most respects to those already described. These

round towers are very numerous in the valley of the Mancos. From this point alone at least three others are in view, some on the higher promontories, others quite low, within twenty or thirty feet of the river-bed. I visited and measured seven along the lower fifteen miles of the course of this stream. In dimensions they range from ten to sixteen feet in diameter and from five to fifteen feet in height, while the walls are from one to two feet in thickness. They are in nearly every case connected with other structures, mostly rectangular in form. At the mouth of the Mancos, however, a double circle occurs, the smaller one having been the tower proper. It is fifteen feet in diameter, and from eight to ten in height. The larger circular wall is forty feet in diameter and from two to four feet high, and is built tangent to the smaller. This ruin is at the point where the Mancos reaches the alluvial bottom bordering the Rio San Juan, and about one mile above its junction with that river. On the opposite or south side of the river are traces of somewhat extensive ruins, but so indistinct that the character of the original structures cannot be made out, and indeed no single mile of the lower fifty of the Mancos is without such remains.

CAÑON OF THE RIO MANCOS.

Fifteen miles from its junction with the San Juan, this stream emerges from the southwest border of the Mesa Verde, through which it has cut its way, producing a most remarkable cañon. This cañon has already been once or twice described; but, in order to make my subsequent descriptions better understood, I shall give here an outline. The Mesa Verde is a somewhat irregular table-land, comprising an area of about seven hundred square miles, and is formed of a great series of nearly horizontal sedimentary rocks, of which the surrounding country has been denuded This series of strata consists, in the upper part, of massive sandstones; in the middle part, of alternating sandstones and shales; and in the lower one thousand feet, chiefly of shales and clay. These softer beds are, when once exposed to the erosive agents, carried away with great rapidity, and, as a consequence, the firmer rocks above are undermined and break down in vertical cliffs, and, where soft and hard beds alternate, a series of steps, with intervening slopes, is formed. It will readily be seen that a cañon thus formed would consist in general of a narrow, irregular river-bottom, long steep slopes of *débris* rising like the arms of a letter V from this, then a succession of steeps and slopes, culminating above in a series of lofty, embattled cliffs. The cañon is nearly thirty miles in length, and ranges from one to two thousand feet in depth. It seems to have been a favorite resort of the cliff-building people, and traces of their industry may be found everywhere, along the bottoms, in the cliffs, and on the high, dry table-lands above.

The four following plates will be taken up in the delineation of the more interesting portions of these remains.

PLATE IV.

Figure 1 illustrates the method of walling up the cave-fronts as described on a preceding page. This sketch was made at the last-mentioned locality on the Rio Mancos. The group occurred in the cliff about thirty feet from the base. The three doorways opened into as many small apartments, and these were connected with each other by very small passage-ways. The farther door could not be reached from the outside, as the platform of rock had broken away.

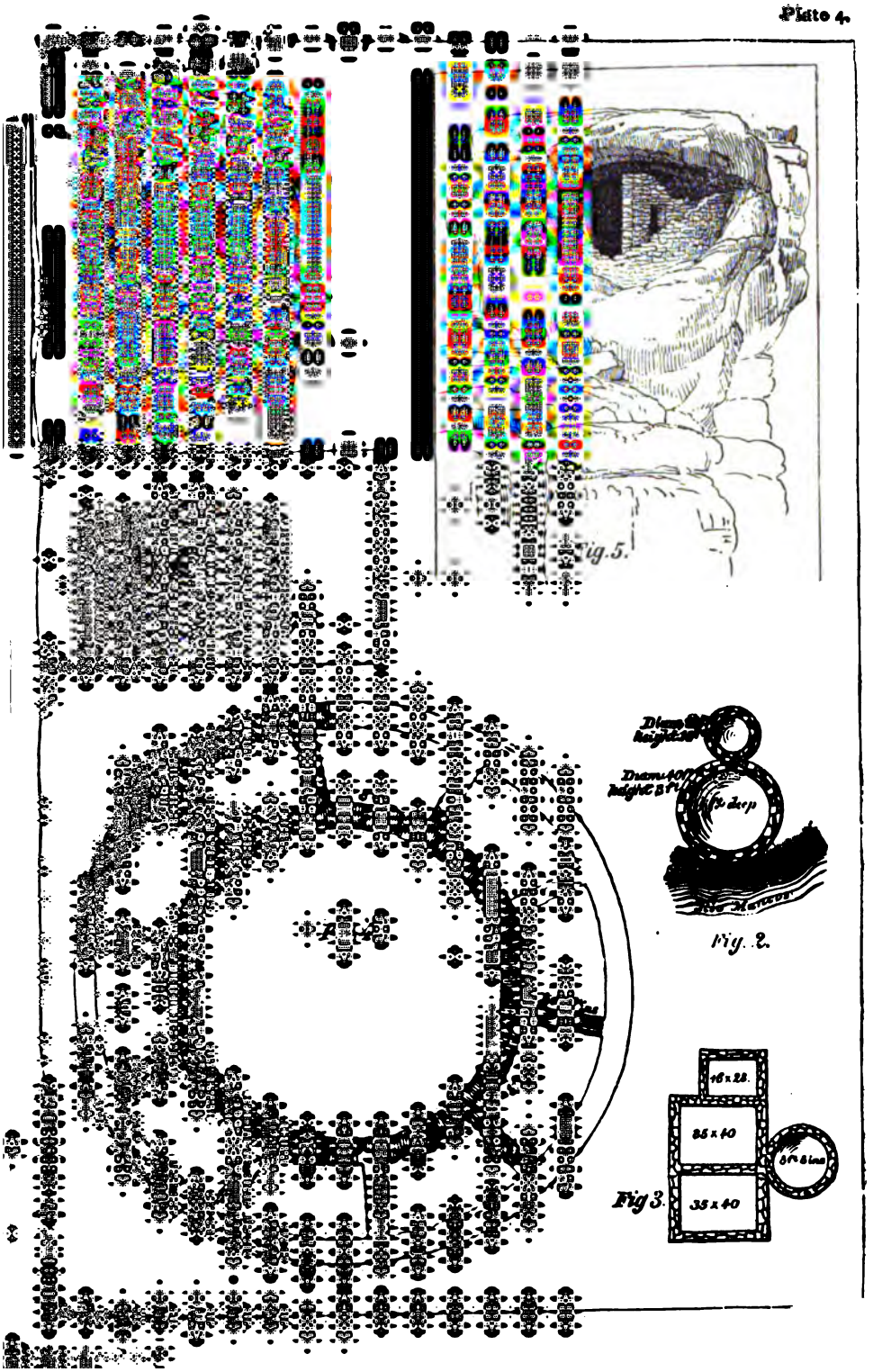


Fig. 5.
Fig. 2.
16 x 28.
35 x 40
35 x 40
Fig 3.

Figure 2 gives a plan of the double tower near the mouth of the Mancos; it has already been described.

The ruin, of which a plan is given in figure 3, occurs on the left bank of the Mancos about eight miles above the foot of the cañon. It is one of the best-preserved specimens of the ruined towers, and seems to have been built with much skill. It is 9 feet in diameter on the inside and about 16 feet high. There are three rectangular apartments attached, the walls of which are almost leveled with the ground. In the side of the tower facing the river is a window, about 8 feet from the ground and 2 feet high by 1½ wide. I had been previously led to the conclusion that these towers were in all cases built without windows or openings of any kind within reach of the ground from without, and it is not improbable that this opening did not communicate with the outside, but served as a doorway between the tower and one of the adjoining apartments. The advantage of such an arrangement in a defensive work, such as we may suppose this to have been, is clearly apparent, and evinces not a little intelligence and forethought on the part of the builders. Being built in connection with dwellings and places of resort, they could, in case of alarm, be reached with ease from within, but be altogether secure from without.

This ruin was visited by Mr. Jackson last year, and a sketch of it has been published.

Figure 4. The large circular ruin, of which a ground-plan is given in this plate, was also visited by Mr. Jackson, photographs were made, and a brief description given; but I deem it best to give a more detailed description, the result of such observations and measurements as could be made in a period of time entirely too short for a work of such importance.

This ruin is situated on a narrow strip of alluvial bottom about midway in the cañon of the Mancos. On first approaching it, one does not observe that it differs greatly from the ordinary fragmentary structures below, as it is much decayed and almost hidden by artemisia and vines. Closer inspection, however, develops the greater part of the outline, and I imagine that a little excavation would bring all the foundations to light. The inner wall can be traced throughout the entire circle, and is in places 6 or 8 feet high. A portion of the outer wall, at the point farthest from the river, is still 12 feet in height and in a fair state of preservation. The space between the walls has been divided into cells, as in the two examples given in plate II. Four of the cross walls are still a number of feet high, while others can be traced by lines of *débris*. The diameter of the outer wall is 43 feet; that of the inner, 25 feet. They are faced up with larger stones than usual (the heaviest of which, however, could be lifted with ease by a single workman), and have been filled in with rubble, adobe, and wood. The outside courses have been dressed to the curve, and the implements used, judging from the appearance of the picked surfaces, have been of stone. The main walls are 21 inches in thickness, while the partition-walls are somewhat lighter, and seem to have been but slightly built into the circular walls.

In order to determine the probable number of these cells, I measured the two having complete walls, and found the inner side of each to be 8 feet. As these were both on one side of the circle, I had but to measure the remaining space to complete the semicircle, and on so doing found that there was just room for three additional cells and the necessary partition-walls; two of these were still traceable. To complete the circle, therefore, ten apartments would be necessary. Being desirous of confirming this conclusion, I took the diameter of the inner circle

as given in my notes, and, by adding twice the thickness of the wall, obtained a circumference of 89½ feet; just sufficient space to accommodate ten apartments, with an equal number of partition-walls a fraction less than 12 inches in thickness.

By adding to the diameter of the inner circle the total thickness of the walls, plus twice the distance between them, I obtained a diameter of 43 feet for the outer circle. The circuit of the structure is, therefore, 135 feet. Although these figures are greater than those previously given (estimated), I am confident that they cannot vary greatly from the truth.

There were no indications of windows or doors in the fragment of outer wall, but two nearly rectangular openings in the inner wall seemto have served as doorways between the central inclosure and the cells. We may suppose that each cell had similar means of communication with the interior. The one doorway that remains entire is 6 feet from the ground, and measures 2 feet in width by 3 in height. The stone-work of the facing is very neat and exact, and the lintel is of a single slab of sandstone. It may be fairly presumed that the outer wall had no doorways or windows within reach of the ground, and that entrance was obtained, by means of ladders, through high windows or by way of the roof. The central inclosure has doubtless served as an *estufa*, and and there are still evidences of a considerable depression.

That this ruin is quite ancient is attested by the advanced stage of decay, and that it has been of considerable height may be inferred from the large quantities of *débris*. A similar and somewhat more perfect example of double-walled tower is illustrated in plate VIII.

There seem to have been no buildings of importance in connection with this ruin, but many in the vicinity. On the point of a low rocky promontory that extends down from the mesa on the west to within a few yards of the circular ruin are some masses of decaying wall, and a large circular depression, not differing in appearance from the usual *estufa*.

It is probable that there are other remains higher up on the rocky slope; indeed, others could be seen from the trail, but I found no time to visit them.

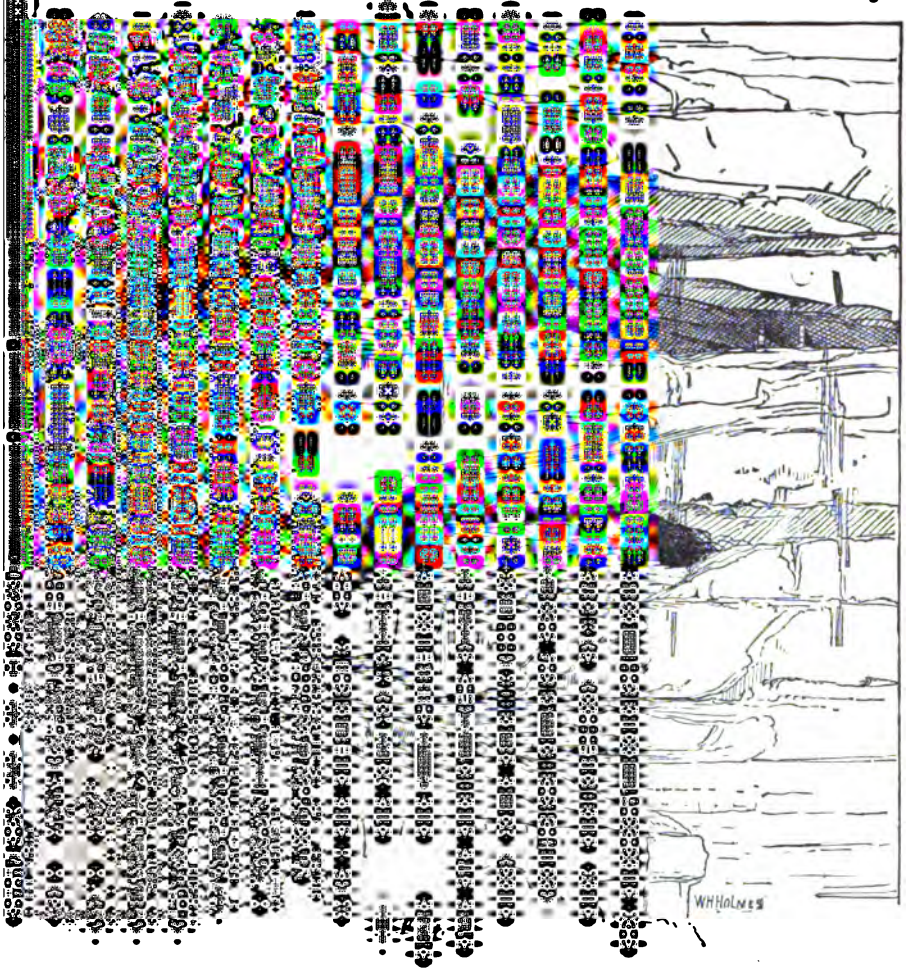
A few hundred yards below the great tower, and very near the trail, a smaller tower occurs, having other ruins connected with it, and in a weather-worn cavity in a massive crag near by is the cosy little dwelling shown in figure 5.

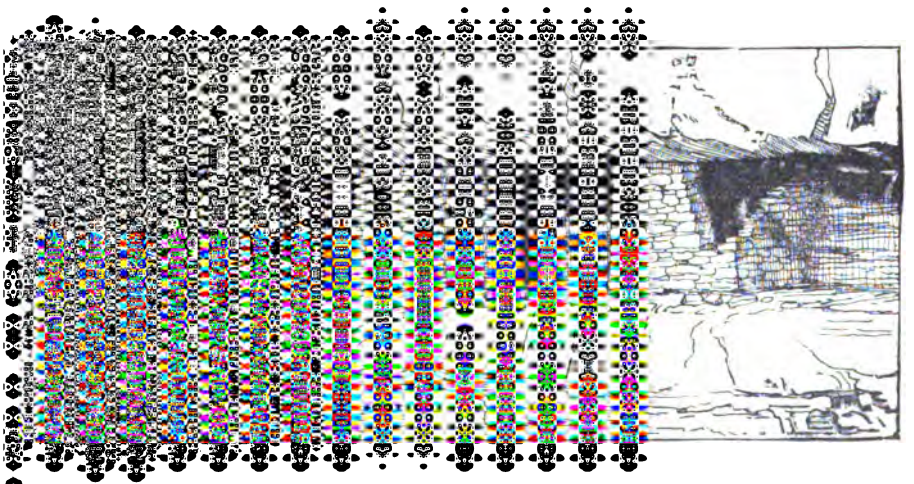
The rude little fire-place illustrated in figure 6 was observed by Mr. Brandegee in connection with a cliff-house on the opposite side of the cañon, a little farther up. It is remarkable as being the only example discovered by our party. There seem to be no traces whatever of fire-places, ovens, furnaces, or chimneys in or about any of the ruins described, which is rather remarkable, since fires must have been used in baking pottery and for domestic purposes, and we cannot suppose that a people so well advanced in architectural skill were unable to build fire-places and furnaces.

PLATE V.—CLIFF-HOUSES OF THE MANCOS.

In this plate are given sketches of two of the more interesting groups of cliff-houses, or fortresses, as they may quite as appropriately be called. Figure 1 represents a portion of a group found about ten miles from the foot of the cañon in a subordinate cliff on the west side. This low cliff is of massive sandstone, and is washed by the river, the trail being crowded back against the steep wall. At the height of about

Plate 5.





forty feet above the river, a bed of shale occurs in the sandstone, which, being easily disintegrated, has been weathered out and carried away, leaving a sort of horizontal groove some four feet high and from four to six feet deep. In this a row of diminutive houses has been built. Three of these are almost perfect, having a fresh new look that certainly belies their age. Four others are much more decayed, and fragments of wall only cling to the cliffs. They have been made to occupy the full height and depth of the crevice, so that when one reaches it at the only accessible point, he is between two houses and must pass through these to get at the others. The doorways are quite small and bear no evidence of the fitting or hanging of doors; and the windows, of which a number open to the front, are but a few inches square.

The walls are strongly built and are from eight to ten inches thick. The stones are small, dressed roughly on the outside, and laid in mortar. In many places, the heavier seams of mortar have been chinked with bits of pottery and small flakes of sandstone. The marks of the masons' pick are as fresh as if made within a few years, and the fine, hard mud-mortar, which has been applied with the bare hands, still retains impressions of the minute markings of the cuticle of the fingers.

The house at the left hand in the drawing has two apartments, the farthest of which has a curved wall conforming with the rounded end of the crevice floor, which, beyond this for some distance, is broken down.

Specimens of the mortar and of the dressed stone were procured from this house and brought east. Below the middle part of this line of houses, on an irregular projection, are the remains of a number of walls, in such a state of ruin, however, that the character of the original structure could not be made out. In digging among the *débris* of this ruin, I came upon a bin of charred corn, in which the forms of the ears were quite perfect. It seems to be of a variety similar to that cultivated by the tribes of the neighborhood at the present time.

That this corn had been placed there by the ancient occupants seems probable from the fact that it occupied a sort of basement apartment or cellar, and had been buried beneath the fallen walls of the superstructures. Imbedded in this mass of charcoal, I found the very perfect specimen of stone implement figured in plate XIV (figure 3). Many large fragments of the ordinary painted pottery were also picked up here. A certain new look about portions of this group leads one to suspect that it cannot boast of great antiquity; but it is very difficult to calculate the effects of age upon walls so perfectly protected and in such a climate.

The group given in figure 2 is of a much more interesting and remarkable character. It was first observed from the trail, far below and nearly three-fourths of a mile away. From this point, by the aid of a field-glass, the sketch given in the plate was made. So cleverly are the houses hidden away in the dark recesses, and so very like the surrounding cliffs in color, that I had almost completed the sketch of the upper house before the lower or "sixteen-windowed" one was detected. They are at least eight hundred feet above the river. The lower five hundred feet is of rough cliff-broken slope, the remainder of massive bedded sandstone full of wind-worn niches, crevices, and caves. Within one hundred feet of the cliff-top, set deep in a great niche, with arched, overhanging roof, is the upper house, its front wall built along the very brink of a sheer precipice. Thirty feet below, in a similar but less remarkable niche, is the larger house, with its long line of apertures, which I afterward found to be openings intended rather for the insertion of beams than for windows.

PLATE VI.

I subsequently climbed the cañon-walls to make a closer examination of these ruins, and the plans given in plate VI were obtained.

The lower house was easily accessible, and proved to be of a very interesting character. It occupies the entire floor of a niche which is about sixty feet long and fifteen in depth at the deepest part. The front walls are built flush with the precipice, and the partition-walls extend back to the irregular wall of rock behind. Portions of the wall at the left, viewing the house from the front, are greatly reduced; but the main wall, that part which contains the window-like openings, is still thirteen or fourteen feet high.

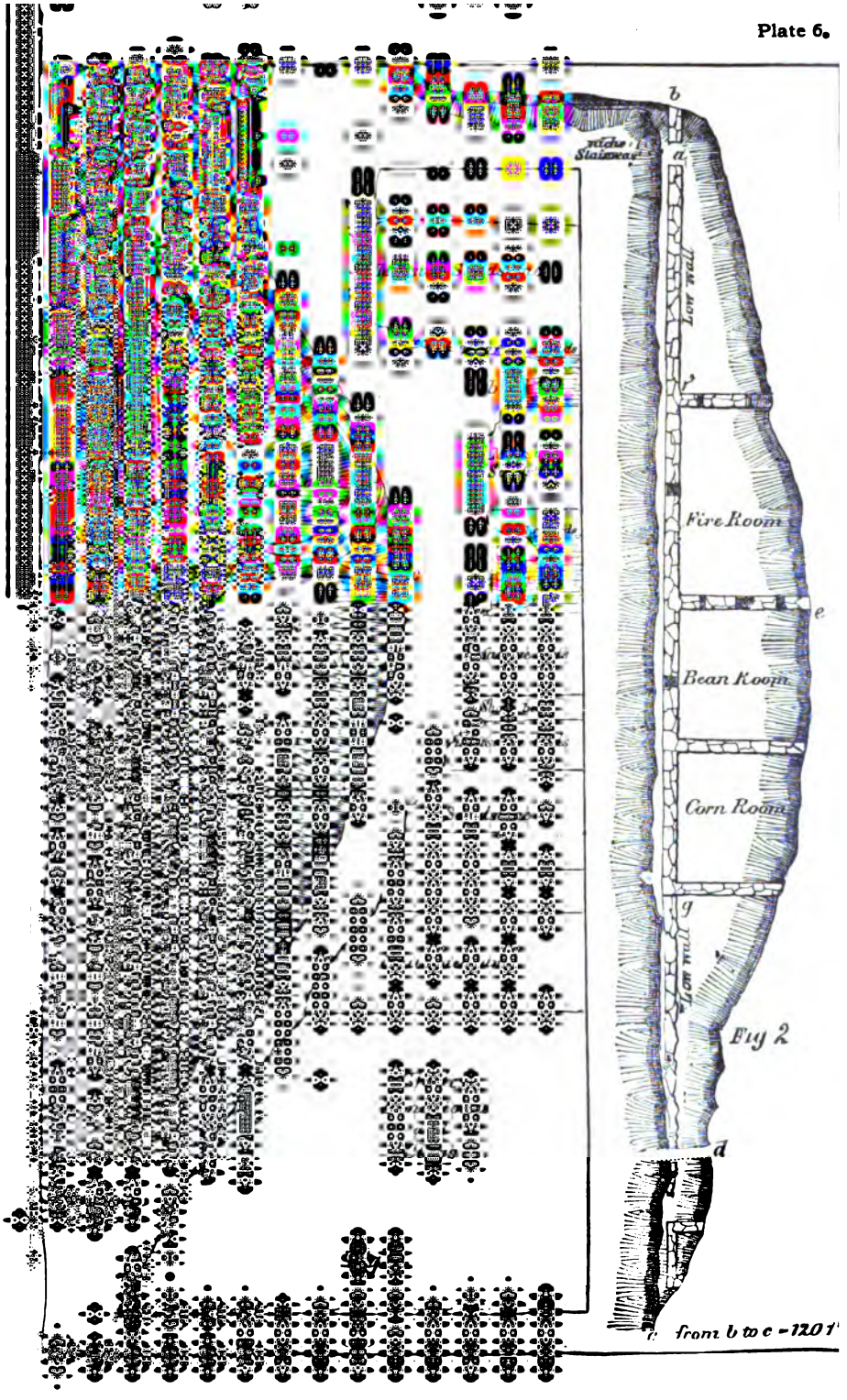
The arrangement of the apartments is quite complicated and curious, and will be more readily understood by a reference to the ground-plan, (figure 1.) The precipice-line, or front edge of the niche-floor, extends from *a* to *b*. From this the broken cliffs and slopes reach down to the trail and river, as shown in the accompanying profile (figure 3). The line *b c d* represents the deepest part of the recess, against which the walls are built. To the right of *b*, the shelf ceases, and the vertical face of rock is unbroken. At the left, beyond *a*, the edge is not so abrupt, and the cliffs below are so broken that one can ascend with ease. Above, the roof comes forward and curves upward, as seen in the profile.

The most striking feature of this structure is the *round room*, which occurs about the middle of the ruin and inside of a large rectangular apartment.

The occurrence of this circular chamber in this place is highly significant, and tends greatly to confirm my previously-stated opinion that the circle had a high significance with these people. Their superstitions seem to have been so exacting in this matter that, even when driven to the extremity of building and dwelling in the midst of these desolate cliffs, an inclosure of this form could not be dispensed with, a circular *estufa* had to be constructed at whatever cost of labor and convenience.

Its walls are not high and not entirely regular, and the inside is curiously fashioned with offsets and box-like projections. It is plastered smoothly, and bears considerable evidence of having been used, although I observed no traces of fire. The entrance to this chamber is rather extraordinary, and further attests the peculiar importance attached to it by the builders, and their evident desire to secure it from all possibility of intrusion. A walled and covered passage-way, *f*, *f*, of solid masonry, ten feet of which is still intact, leads from an outer chamber through the small intervening apartments into the circular one. It is possible that this originally extended to the outer wall, and was entered from the outside. If so, the person desiring to visit the *estufa* would have to enter an aperture about twenty-two inches high by thirty wide, and crawl, in the most abject manner possible, through a tube-like passage-way nearly twenty feet in length. My first impression was that this peculiarly-constructed doorway was a precaution against enemies, and that it was probably the only means of entrance to the interior of the house; but I am now inclined to think this hardly probable, and conclude that it was rather designed to render a sacred chamber as free as possible from profane intrusion. The apartments *l*, *k*, *m*, *n*, do not require any especial description, as they are quite plain and almost empty. The partition-walls have never been built up to the ceiling of the niche, and the inmates, in passing from one apartment to another, have climbed over. The row of apertures indicated in the main front wall are about five feet from the floor, and were doubtless intended for the

Plate 6.


b
Niche Stairway
a
Low Wall
f
Fire Room
e
Bean Room
Corn Room
g
Low Wall
Fig 2
d
c
from b to c = 120 f

insertion of beams, although there is no evidence that a second floor has at any time existed. In that part of the ruin about the covered passage-way, the walls are complicated, and the plan can hardly be made out, while the curved wall inclosing the apartment *e* is totally overthrown.

In digging among the *débris* with our hammers, we came upon a large earthen vessel at *h*, and shortly afterward discovered another near *i*. They were so situated in a small recess under the sheltering walls that the falling rubbish had not reached them. Roughly-hewn stone lids were fitted carefully over the tops, but both were empty. One had been slightly broken about the rim, while the other had been pierced on the underside by some sharp instrument, and had been mended by laying a small fragment of pottery over the aperture on the inside and cementing it down with clay. They are of the ordinary corrugated pottery, and have a capacity of about three gallons.

Beneath the vessels, spread out on the floor, was a large piece of rush-matting, and beneath this a quantity of fine vegetable tissue from the interior bark of some kind of tree. The vessels are illustrated in plate XIII, and the matting in plate XIV.

The rock-face between this ruin and the one above is smooth and vertical, but by passing along the ledge a few yards to the left a sloping face was found, up which a stairway of small niches had been cut; by means of these, an active person, unincumbered, could ascend with safety. On reaching the top, one finds himself in the very doorway of the upper house (*a*, figure 2) without standing room outside of the wall, and one can imagine that an enemy would stand but little chance of reaching and entering such a fortress if defended, even by women and children alone. The position of this ruin is one of unparalleled security, both from enemies and from the elements. The almost vertical cliff descends abruptly from the front wall, and the immense arched roof of solid stone projects forward 15 or 20 feet beyond the house (see section, figure 3). At the right the ledge ceases, and at the left stops short against a massive vertical wall. The niche-stairway affords the only possible means of approach.

The house occupies the entire floor of the niche, which is about 120 feet long by 10 in depth at the deepest part. The front wall to the right and left of the doorway is quite low, portions having doubtless fallen off. The higher wall *f g* is about 30 feet long, and from 10 to 12 feet high, while a very low rude wall extends along the more inaccessible part of the ledge, and terminates at the extreme right in a small inclosure, as seen in the plan at *c*.

In the first apartment entered, there were evidences of fire, the walls and ceiling being blackened with smoke. In the second, a member of the party,* by digging in the rubbish, obtained a quantity of beans, and in the third a number of grains of corn, hence the names given. There are two small windows in the front wall, and doorways communicate between rooms separated by high partitions.

The walls of these houses are built in the usual manner, and average about a foot in thickness.

The upper house seems to be in a rather unfinished state, looking as if stone and mortar had run short. And when one considers that these materials must have been brought from far below by means of ropes, or carried in small quantities up the dangerous stairway, the only wonder is that it was ever brought to its present degree of finish.

* Mr. Brandegee.

Figure 3 is given for the purpose of making clear the geologic conditions that give shape to the cliffs as well as to show the relations of these houses to the cliffs. The hard and massive beds of rock resist the erosive agents; the soft and friable beds yield, hence the irregularity—the overhanging cliffs, the niches and benches. *a* is a section of the lower house, *b* of the upper.

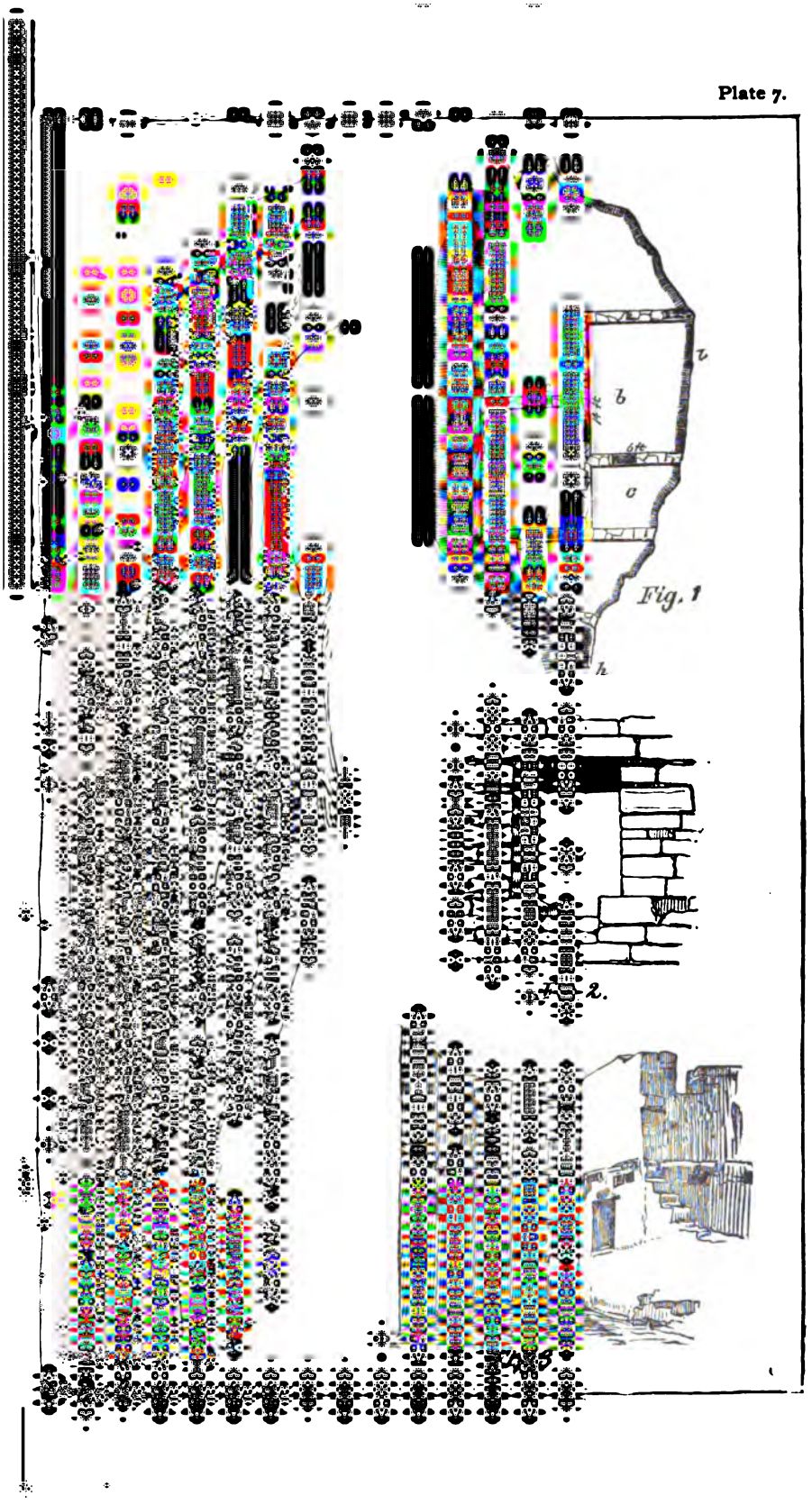
It has heretofore been supposed that the occupants of these houses obtained water, either from the river below or from springs on the mesa above; but the immense labor of carrying water up these cliffs, as well as the impossibility of securing a supply in case of siege, made me suspect the existence of springs in the cliffs themselves. In three or four cases these springs have been found, and it is evident that with a climate a very little more moist than the present, a plentiful supply could be expected. Running water was found within a few yards of the group of houses just described, and Mr. Brandegee observed water dripping down the cliffs near a group of small houses on the opposite side of the cañon.

About one mile farther up the cañon, I came upon the ruin photographed by Mr. Jackson in 1874, and minutely described by him as the two-story cliff-house of the Rio Mancos. It is also in the cliffs of the north side, about seven hundred feet above the river, and although not so large or complicated in design as the houses just described, it shows higher skill in construction and is in a better state of preservation. It is also exceedingly difficult of access. It seems hardly necessary for me to enter into a detailed description, as little can be added to what has already been published;* but for the purpose of having as much of the matter together as possible I present plate VII, illustrating some of the interesting features of this house.

Figure 1 gives the ground-plan, and shows the position of the house in relation to the floor of the niche. There are four small apartments only; the front one, *a*, being 10 feet long by 6 wide. Of the back rooms, one is 9 by 10 and the other 6 by 6 feet, while the apartment with the curved wall is much smaller. The walls are about twelve feet high and reach within from two to three feet of the overhanging roof. They are built in the ordinary manner of stone and adobe mortar, and what is rather remarkable are plastered both inside and out. This plaster does not differ greatly from the common mortar, is lightly spread over the walls, probably with the hands, and in color imitates very closely the hues of the surrounding cliffs, a pleasing variety of red and yellow grays. Whether this was intended to add to the beauty of the dwelling or to add to its security by increasing its resemblance to the surrounding cliffs, I shall not attempt to determine.

Another remarkable feature of this house is the consummate skill with which the foundations are laid upon and cemented to the sloping and overhanging faces of the ledge. The buttresses *b*, *b*, which have probably at one time supported a superstructure of wood or stone, now totally obliterated, are most striking illustrations of this; and just here is a fact that has an interesting bearing upon the question of the antiquity of this structure. These wall-supports, or buttresses, have originally been four in number, one evidently having fallen off, and are built in continuation of the front wall, on a smooth, sloping surface of rock. Now the sandstone of which this rounded slope is composed is rather coarse and soft, and hence easily disintegrated. It is here also not greatly protected from the weather, since the cliffs above do not

*Bulletin No. 1, second series, p. 20.


b
c
h
Fig. 1
Fig. 2.

overhang to any extent, and must, year by year, yield a little to the elements; but I observe that since the construction of these foundations no perceptible change has taken place; the thickness of a sheet of paper has hardly been washed from the surface of the rock, and the mortar, which is of almost equal firmness with the rock, lies upon it as if placed there within a dozen years, and the plaster on the outer wall, although somewhat cracked and broken off, does not add greatly to our impressions of antiquity.

There is also a fact worthy of notice in regard to the question of occupancy. I have already stated my impression that these houses were not used as constant dwelling-places, but rather as places of occasional resort. I notice that, although the building seems complete and has had its floors laid and its doorways and windows conveniently and carefully arranged, the plastering of the interior is almost untouched, that with the exception of three names scratched in the soft, thick coat of adobe by Mr. Jackson's party, there is almost no trace of the presence of man; yet this plaster may have been applied only shortly before the final desertion, and hence no definite conclusion can be drawn.

A sketch of one of the door-ways is given in figure 2. The outline is accurately drawn, but there is a little too much regularity in the stonework. It will be seen that the aperture is of very nearly the same width above and below, which is rather unusual, since, in these ruins, as well as in those farther south, the door-ways and windows are, as a rule, narrower at the top. This drawing also shows the manner of employing a number of small straight beams of wood as lintels, for the purpose, evidently, of strengthening the masonry above.

There are two of these exterior door-ways only, one opening into each story of the front room from the unoccupied part of the niche; these are shown in figure 3, a sketch of the interior of the front room taken from the side *f*. There is only a low wall between this room and the room *c*, while small door-ways communicate with the other apartments. There is a small rectangular window, 22 inches high by 30 wide, in the front wall, from which a fine view can be had of the deep narrow valley below.

Figure 4 is designed to show the extraordinary situation of these houses. Whether viewed from below or from the heights above the effect is almost startling, and one cannot but feel that no ordinary circumstances could have driven a people to such places of resort.

There are no ruins of importance in the cañon of the Mancos above the two-story house. Indistinct remains occur on the bottoms in a number of places, and a few small houses were observed in the cliffs. The most interesting of these is built upon a ledge about 40 feet above the trail, and is nearly midway between the two-story house and the head of the cañon. It does not differ in any essential point from the ruins already described. I shall therefore pass it by, in order to take up two very interesting groups of ruins that occur about twenty miles to the northwest.

Between the Mesa Verde and the Late Mountains, of which Ute peak is the culminating summit, there is a long, deep valley or strip of lowland that connects the great lowland of the Lower Mancos with the cañon-cut plain that rises toward the Dolores. The southern end of this depressed strip drains into the Mancos, the northern into the McElmo. The latter stream heads along the north base of the Mesa Verde within five miles of the Mancos at the point where it enters the cañon, and flows westward, passing along the north base of Ute Mountain, curving around to the southwest and reaching the San Juan nearly ten miles

beyond the Utah line. The large depressed area drained by this stream contains a great number of ruins, many of which have not yet been examined.

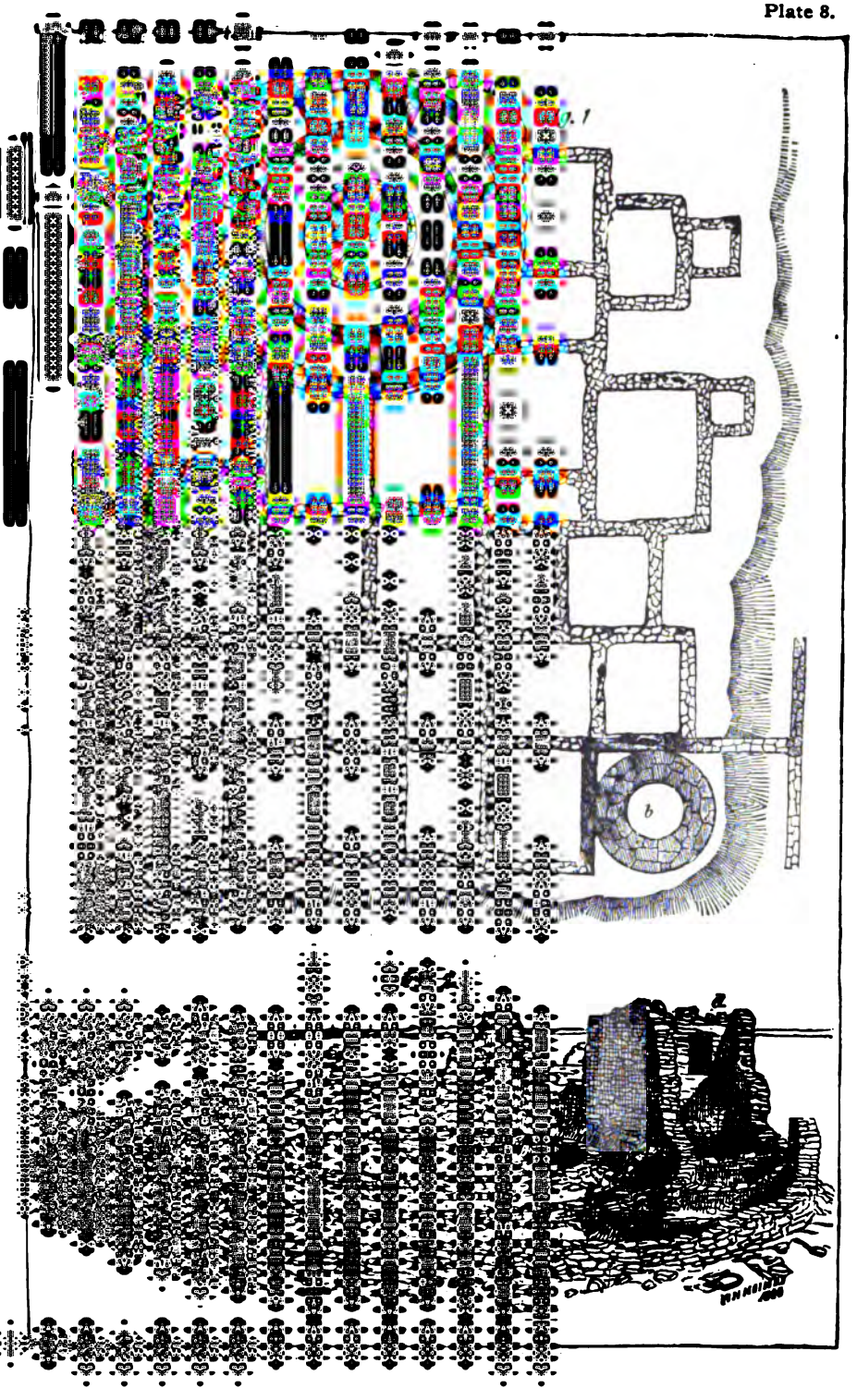
PLATE VIII.—THE TRIPLE-WALLED TOWER.

The group partially illustrated in this plate is situated on a low bench within a mile of the main McElmo, and near a dry wash that enters that stream from the south. It seems to have been a compact village or community-dwelling, consisting of two circular buildings and a great number of rectangular apartments. The circular structures or towers have been built, in the usual manner, of roughly-hewn stone, and rank among the very best specimens of this ancient architecture. The great tower is especially noticeable on account of the occurrence of a third wall, as seen in the drawing and in the plan at *a*. In dimensions it is almost identical with the great tower of the Rio Mancos. The walls are traceable nearly all the way around, and the space between the two outer ones, which is about five feet in width, contains fourteen apartments or cells. The walls about one of these cells are still standing to the height of 12 feet; but the interior cannot be examined on account of the rubbish which fills it to the top. No openings are noticeable in the circular walls, but door-ways seem to have been made to communicate between the apartments; one is preserved at *d*.

The inner wall has not been as high or strong as the others, and has served simply to inclose the *estufa*. This tower stands back about one hundred feet from the edge of the mesa and near the border of the village. The smaller tower, *b*, stands forward on a point that overlooks the shallow gulch; it is 15 feet in diameter; the walls are 3½ feet thick and 5 feet high on the outside. Beneath this ruin, in a little side gulch, are the remains of a wall twelve feet high and twenty inches thick. The remainder of the village is in such a state of decay as to be hardly traceable among the artemisia and rubbish. The apartments number nearly a hundred, and seem, generally, to have been rectangular. They are not, however, of uniform size and certainly not arranged in regular order. The walls are marked by low lines of loose rubble which show no stone in place, and I am inclined to believe that they have never been raised to any great height. It is not impossible that they have been, originally, of a species of rubble-masonry such as is seen in some of the great *casas* farther south, and that these meager remains are all that is left of an imposing structure, but the total want of regularity both in the form and size of the apartments seems inconsistent with such a conclusion. In reality they are more like a cluster of pens such as are used by the Moqui tribes for the keeping of sheep and goats. The site of this village can hardly have been chosen on account of its defensive advantages, nor on account of the fertility of the surrounding country. The neighboring plains and mesas are as naked and barren as possible. The nearest water is a mile away, and during the drier part of the season the nearest running water is in the Rio Dolores, nearly fifteen miles away. To suppose an agricultural people existing in such a locality, with the present climate, is manifestly absurd. Yet every isolated rock and bit of mesa within a circle of miles is strewn with remnants of human dwellings.

PLATE IX.—RUINS AT "AZTEC SPRINGS."

Another very important group of ruins is located in the depression between the Mesa Verde and the Late Mountains, and near the divide


b
a

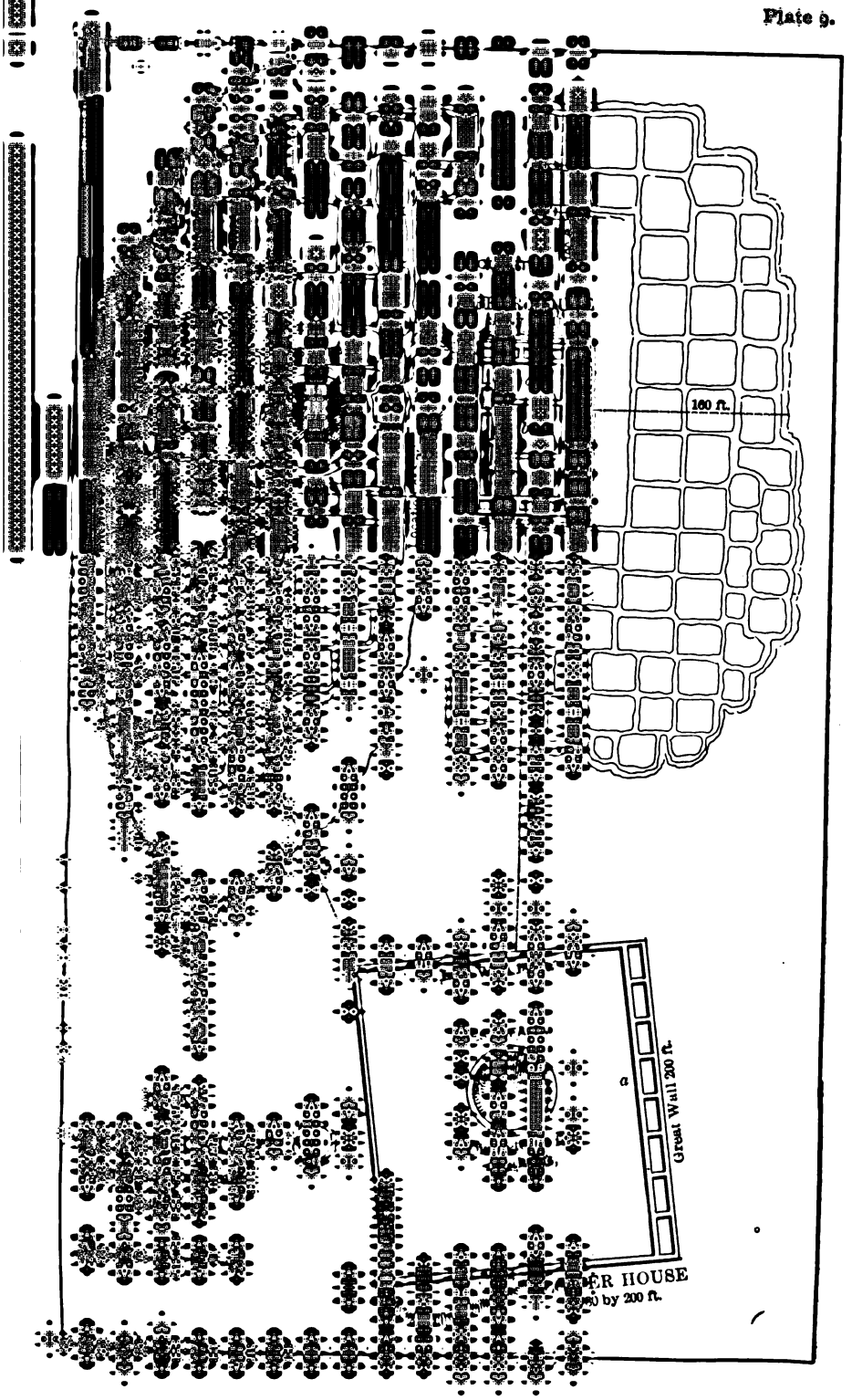

160 ft.
Great Wall 200 ft.
a
ER HOUSE
0 by 200 ft.

Plate 10.

between the McElmo and Lower Mancos drainage. It is stated by Captain Moss and others who have been in this locality that up to within two or three years there has been a living-spring at this place, and the spot has been christened by them Aztec Springs.

The site of the spring I found, but without the least appearance of water. The depression formerly occupied by it is near the center of a large mass of ruins, similar to the group last described, but having a rectangular instead of a circular building as the chief and central structure. This I have called the *upper house* in the plate, and a large walled inclosure a little lower on the slope, I have, for the sake of distinction, called the *lower house.*

These ruins form the most imposing pile of masonry yet found in Colorado. The whole group covers an area of about four hundred and eighty thousand square feet, and has an average depth of from three to four feet. This would give in the vicinity of one million five hundred thousand solid feet of stone-work. The stone used is chiefly of the fossiliferous limestone that outcrops along the base of the Mesa Verde a mile or more away, and its transportation to this place has doubtless been a great work for a people so totally without facilities.

The upper house is rectangular, measures 80 by 100 feet, and is built with the cardinal points to within five degrees. The pile is from 12 to 15 feet in height, and its massiveness suggests an original height at least twice as great. The plan is somewhat difficult to make out on account of the very great quantity of *débris.*

The walls seem to have been double, with a space of 7 feet between; a number of cross-walls at regular intervals indicate that this space has been divided into apartments, as seen in the plan.

The walls are 26 inches thick, and are built of roughly-dressed stones, which were probably laid in mortar, as in other cases.

The inclosed space, which is somewhat depressed, has two lines of *débris*, probably the remains of partition-walls, separating it into the three apartments, *a*, *b*, *c*. Inclosing this great house is a net-work of fallen walls, so completely reduced that none of the stones seem to remain in place; and I am at a loss to determine whether they mark the site of a cluster of irregular apartments, having low, loosely-built walls, or whether they are the remains of some imposing adobe structure built after the manner of the ruined pueblos of the Rio Chaco.

Two well-defined circular inclosures or estufas are situated in the midst of the southern wing of the ruin. The upper one, *A*, is on the opposite side of the spring from the great house, is 60 feet in diameter, and is surrounded by a low stone wall. West of the house is a small open court, which seems to have had a gate-way opening out to the west, through the surrounding walls.

The lower house is 200 feet in length by 180 in width, and its walls vary fifteen degrees from the cardinal points. The northern wall, *a*, is double, and contains a row of eight apartments about 7 feet in width by 24 in length. The walls of the other sides are low, and seem to have served simply to inclose the great court, near the center of which is a large walled depression, (estufa *B*.) No other ruins were observed in the neighborhood of these, although small groups are said to exist along the base of the Late Mountains, a few miles to the southwest.

PLATE X.—RUIN AT OJO CALIENTE, NEW MEXICO.

For the sake of comparison, I present in Plate X, the ground-plan of a ruined pueblo found at *Ojo Caliente*, New Mexico. It occurs on a high,

almost isolated fragment of terrace near Caliente Creek. It has been constructed chiefly of adobe, and has consisted of rows of apartments surrounding a number of large open courts. Individual walls cannot be traced, and the rows of houses are reduced to smooth rounded ridges of earth. These are indicated on the plan, and are often as much as 8 feet high, and 30 feet wide at the base. The courts contain a number of small circles and mounds, *a*, *a*, and the single *estufa* is identical in appearance with those among the ruins of Colorado. A number of openings, *b*, *b*, through the walls indicate the location of gate-ways. *Metates*, arrow-heads, and many fragments of pottery were found. Many other groups of ruins similar to this occur in this as well as in the neighboring valleys. Near Abiquiu, a large pueblo occurs, at which I found a stone axe and a number of arrow-heads and *metates*. A couple of skeletons were also obtained here. This ruin is described at length by Dr. Yarrow, in his report for 1874.*

PLATES XI AND XII.

Although it is quite impossible to read the curious rock-inscriptions of unknown tribes, or even to conjecture to any extent their meaning, yet it is conceded that in most cases they have a meaning and represent an idea or record an event. Aside from this, however, they are valuable to the historian as records of the grade of civilization reached by the tribes who executed them.

That the examples given in the two following plates, belong to the age of the cliff-builders cannot be satisfactorily proved, but, at the same time, evidence that they do, is not wanting. Some are found on the cliffs and in the niches with the cliff-dwellings, while all are in localities that must have been frequently visited by these people. Some are found in the cañon of the Mancos, others on the bluffs of the San Juan, and many in the cañons farther west.

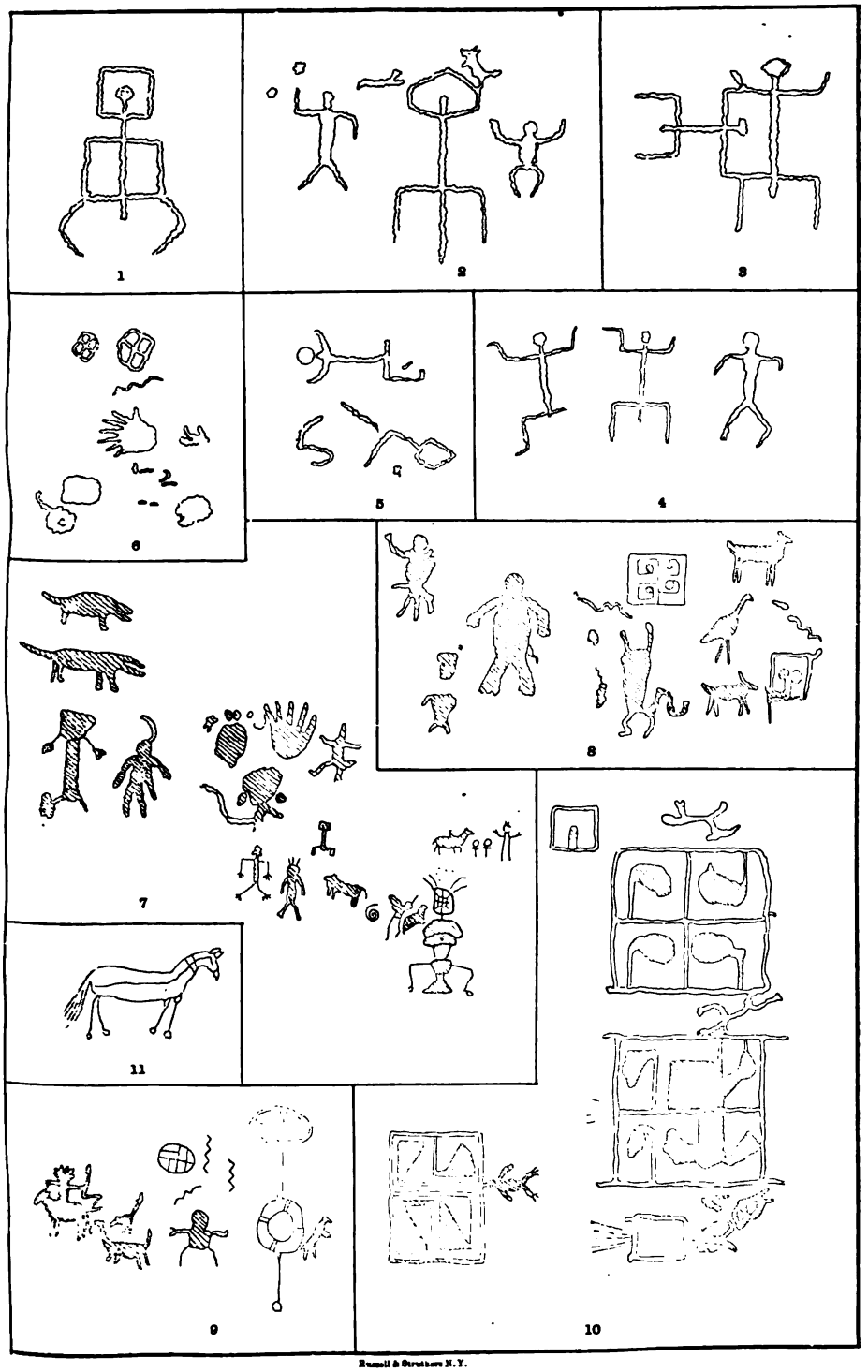
Figures 1, 2, and 3, Plate XI, occur on the Mancos near the group of cliff-houses figured in Plate V. They are chipped into the rock, evidently by some very hard implement, and rudely represent the human figure. They are certainly not attempts to represent nature, but have the appearance rather of arbitrary forms designed to symbolize some imaginary being.

Figures 4, 5, and 6 were found in the same locality, not engraved, but painted in red and white clay upon the smooth rocks. These were certainly done by the cliff-builders, and probably while the houses were in process of construction, since the material used is identical with the plaster of the houses. The sketches and notes were made by Mr. Brandegee. The reproduction is approximately one-twelfth the size of the original.

The examples given in figures 7, 8, 9, 10, and 11, as well as those in Plate XII, occur on the Rio San Juan about ten miles below the mouth of the Rio La Plata. A low line of bluffs, composed of light-colored massive sandstones, that break down in great smooth-faced blocks, rises from the river-level and sweeps around toward the north. Each of these great blocks has offered a very tempting tablet to the graver of the primitive artist, and very many of them contain curious and interesting inscriptions. Drawings were made of such of these as the limited time at my disposal would permit. They are all engraved or cut into the face of the rock, and the whole body of each figure has generally been chipped out, frequently to the depth of one-fourth or one-half an inch.

The work on some of the larger groups has been one of immense

* Report of the Chief of Engineers for 1875, page 1064.



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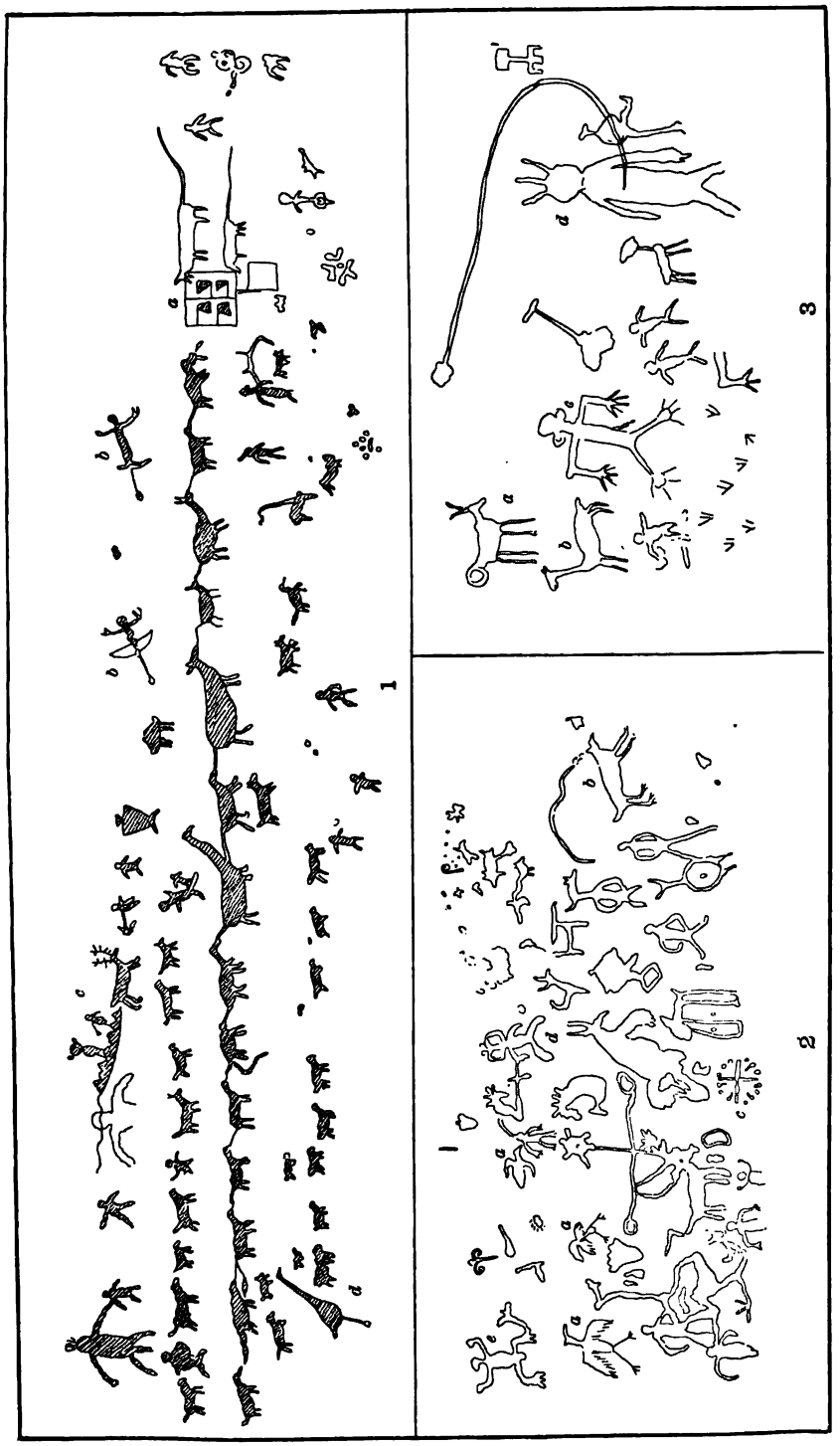
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labor, and must owe its completion to strong and enduring motives. With a very few exceptions the engraving bears undoubted evidence of age. Such new figures as occur are quite easily distinguished, both by the freshness of the chipped surfaces and by the designs themselves. Figure 11 gives a specimen of the modern work; it is evidently intended to represent a horse, and is done in the manner of the Navajoes. It will readily be seen that among all the figures given of the ancient work there is no animal that resembles a horse, and we can hardly suppose that artists who could so cleverly delineate birds and deer and men, would fail in an attempt to represent an animal of so marked a character. The curious designs given in figure 10 have a very perceptible resemblance to many of the figures used in the embellishment of pottery.

The most striking group observed is given in figure 1, Plate XII. It consists of a great procession of men, birds, beasts, and fanciful figures. The whole picture as placed upon the rock is highly spirited, and the idea of a general movement toward the right, skillfully portrayed. A pair of winged figures hover above the train as if to watch or direct its movements; behind these are a number of odd figures, followed by an antlered animal resembling a deer, which seems to be drawing a notched sledge containing two figures of men. The figures forming the main body of the procession appear to be tied together in a continuous line, and in form resemble one living creature about as little as another. Many of the smaller figures above and below are certainly intended to represent dogs, while a number of men are stationed about, here and there, as if to keep the procession in order.

As to the importance of the event recorded in this picture no conclusions can be drawn; it may represent the migration of a tribe or family or the trophies of a victory. A number of figures are wanting in the drawing at the left, while some of those at the right may not belong properly to the main group. The reduction is, approximately, to one-twelfth.

Figures 2 and 3 of the same plate represent only the more distinct portions of two other groups. The complication of figures is so great that a number of hours would have been necessary for their delineation, and an attempt to analyze them here would be fruitless.

PLATE XIII.—POTTERY.

It is generally conceded that the ancient tribes of the San Juan produced fictile fabrics superior to those of the town building tribes of to-day. There is, however, great similarity between the ancient and modern work, both in material and execution, and the differences are not greater than could be expected in the manufactures of the same tribe at periods separated by two or three centuries of degeneration.

The study of the fragmentary ware found about the ruins is very interesting, and its immense quantity is a constant matter of wonder. On one occasion, while encamped near the foot of the Mancos Cañon, I undertook to collect all fragments of vessels of manifestly different designs within a certain space, and by selecting pieces having peculiarly marked rims I was able to say with certainty that within ten feet square there were fragments of fifty-five different vessels. In shape these vessels have been so varied that few forms known to civilized art could not be found. Fragments of bowls, cups, jugs, pitchers, urns, and vases, in infinite variety may be obtained in nearly every heap of *débris*.

The art of ornamentation seems to have been especially cultivated, as

very few specimens are found that are not painted, indented, or covered with raised figures. Indeed, these ornamental designs are often so admirable, and apparently so far in advance of the art-ideas of these people in other respects, that one is led to suspect that they may be of foreign origin. This suspicion is in a measure confirmed when we discover the scroll and the fret struggling for existence among the rude scrawlings of an artisan who seems to have made them recognizable rather by accident than otherwise. It is not improbable, however, that the specimens referred to are but rude copies of models designed by more accomplished artists or procured from some distant tribe. There is certainly no conclusive evidence that these people ever came in contact with Europeans.

The material used in the manufacture of pottery is generally a fine clay, (in which the country abounds,) tempered with sand or pulverized shells. The modeling is done almost exclusively with the hand; no wheel has been used, and no implement whatever, except for surface creasings or indentings.

The thickness of the ware varies from ⅛ to ½ an inch. Lightness has evidently been greatly desired, and vessels having a capacity of many gallons are not more than ¼ of an inch thick in any part.

Nearly all of the vessels and fragments collected have been baked or burned, but not to such a degree as to greatly change the color of the clay. Most, if not all, of the painted pottery is glazed with a very thin vetreous coating that gives a beautiful enamel-like surface of great hardness; upon this the coloring-matter is laid, apparently with a brush. With one or two exceptions the corrugated pottery is without the glazing, and in no instance contains painted figures. The peculiarities of this variety can be described more readily by reference to the examples in the plate.

Figure 1 represents a large vessel obtained in one of the Mancos cliff-houses, (Plate VI). It is of the corrugated variety; has a capacity of about three gallons, and was probably used for carrying or keeping on hand a supply of water. It is quite light, not weighing more than a common wooden pail, and is made of a light-gray clay tempered with coarse sand, and but slightly burned. The corrugated appearance is given by laying on strips of clay, in somewhat regular succession, and pressing them into place and indenting them with the thumb or a stick. Whether a thin shell of clay is first constructed and the strips laid on and pressed down so as to unite with it, or whether the vessel is built up by the strips alone, cannot be determined, since the inside is perfectly smooth, excepting finger-marks, and the strips are so welded into the general texture of the vessel that individual strips cannot be detected beneath the surface when examined on broken edges.

In the specimen figured the workman has begun near the center of the rounded bottom and laid a strip in a continuous but irregular spiral (see Fig. 3) until the rim was reached, indenting the whole surface irregularly with the finger. Two small conical bits of clay have been set in near the rim, as if for ornament. Other specimens have small spirals, while others have scrolls, and still others very graceful festoons of clay, (Figs. 2 and 2*a*.) A number of the more distinct styles of indentation are given in connection with this figure, (Figs. 3, 3*a*, 3*b*, 3*c*, and 3*d*.)

Figure 4 is a bowl restored from a large fragment. It is painted both inside and out, and the designs are applied with rather more than usual care.

Figures 5, 5*a*, and 5*b* are prominent among the ornamental designs. I have corrected the drawing, but have introduced no new element.

Plate 13.

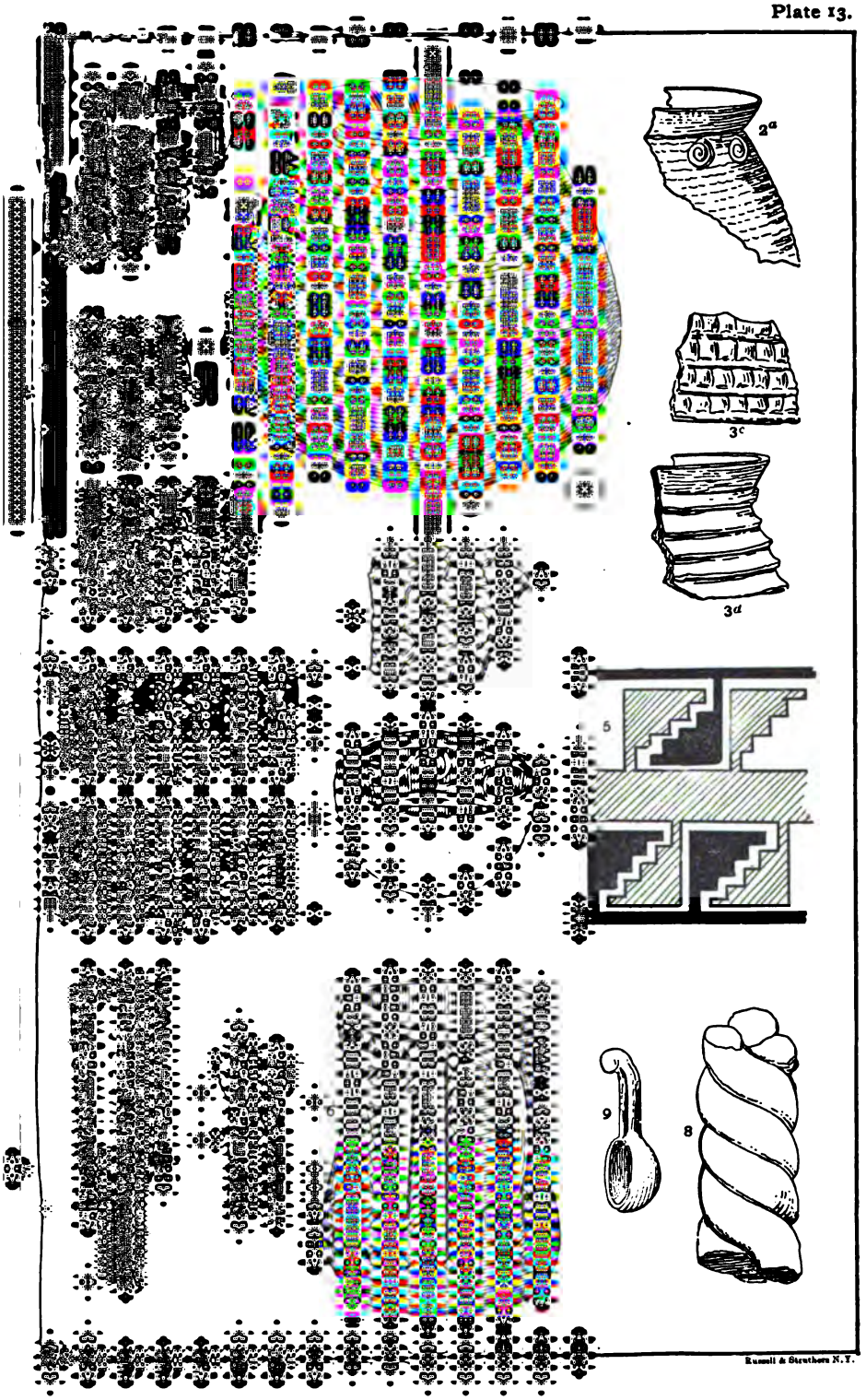

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Figure 6 represents a very usual pattern of mug or cup. It is of the ordinary painted ware, and is made to contain about a pint. The specimen is not entire.

Figure 7 is apparently a pipe. It was found by Mr. Aldrich, near a ruin on the San Juan, and is made of the ordinary potter's clay; it is 2 inches in length.

Figure 8 represents part of an ornamental handle, formed by twisting together three small rolls of clay.

Figure 9 represents a small spoon or ladle. Fragments of similar implements are quite numerous.

Figure 10 is a portion of the handle of some small vessel.

As to whether the manufacture of pottery was carried on in certain favorable localities only, or whether each village had its own skilled workmen or workwomen, I cannot determine, since, as previously stated, no remains of kilns or manufactories were discovered. The forms and styles of ornament are pretty uniform, which is to be expected in either case, since the inhabitants of the various villages must have had constant communication with each other.

PLATE XIV.

This plate contains drawings of a number of stone implements, arrowheads, ornaments, and other articles manufactured or used by the ancient inhabitants of this region. Nearly all were found so associated with the architectural remains that I do not hesitate to assign them to the same period.

Figure 1 represents a small fragment of rush matting, a large piece of which was found on the floor of one of the cliff-houses of the Rio Mancos. (See Plate VI.) It is probably manufactured from a species of rush, *Scirpus validus*, that grows somewhat plentifully along the Mancos bottoms.

Figure 2 represents a bundle of small sticks, probably used in playing some game. They are nearly a foot in length, and have been sharpened at one end by scraping or grinding. They were found in one of the cliff-houses of the Mancos, buried beneath a pile of rubbish. The bit of cord with which they are tied is made of a flax-like fiber, carefully twisted and wrapped with coarse strips of *yucca* bark; beside this a number of short pieces of rope of different sizes were found, that in beauty and strength would do credit to any people. The fiber is a little coarser and lighter than flax, and was probably obtained from a species of *yucca*, which grows everywhere in the southwest.

Figure 3 is a very perfect specimen of stone implement found buried in a bin of charred corn in one of the Mancos cliff-houses (figure 1, Plate V). It is 8 inches in length and 2½ inches broad at the broadest part; its greatest thickness is only ½ an inch. One face is slightly convex, while the other is nearly flat. The sides are neatly and uniformly rounded, and the edge is quite sharp. It is made of a very hard, fine-grained, siliceous slate, is gray in color, and has been ground into shape and polished in a most masterly manner.

Although its use is not positively determined, it belongs, in all probability, to a class of implements called "scrapers," which are employed by most savage tribes in the dressing of skins. This specimen may have been used for other purposes, but certainly not for cutting or striking, as the material is very brittle. The most conclusive proof of its use is the appearance of the edge, which shows just such markings as would be produced by rubbing or scraping a tough, sinewy surface.

Figure 4 represents a part of a *metate* or mill-stone. The complete im-

plement consists of two parts—a large block of stone with a concave surface, upon which the maize is placed, and a carefully-dressed but coarse-grained slab of stone for grinding. This slab is generally from 8 to 12 inches long by 3 to 6 wide, and from 1 to 2 inches thick. The specimen illustrated is made of black cellular basalt, and was found with many others at the ruined pueblo near Ojo Caliente, N. Mex. (Plate X).

Figure 5 is a very much worn specimen of stone axe, which was found at an ancient ruin near Abiquiu, N. Mex. It is made of light-colored chloritic schist, and measures 2 inches in width by 3 in length.

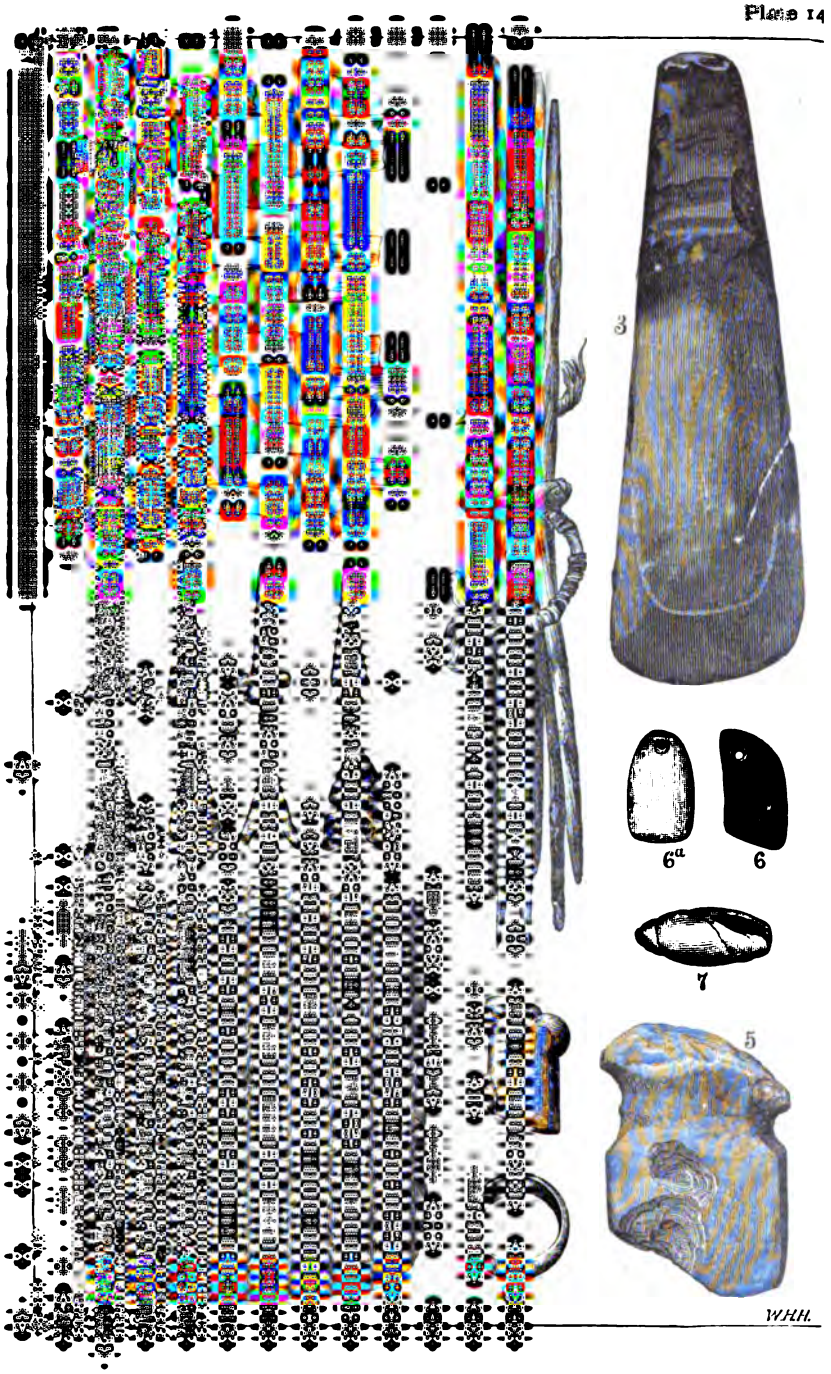
Figures 6 and 6*a* are specimens of ear-ornaments, such as are found in connection with very many of the ruins of Southern Colorado. These are made of fine-grained gray slate, only moderately well polished, and measure an inch and a quarter in length.

Figure 7 represents a marine shell of the genus *Olivella*, obtained probably from the Pacific coast. Large numbers of this and allied shells are found about these ruins. They are generally pierced, and were doubtless used as beads.

Figure 8 represents a small carved figure found on the Rio Mancos. It is made of hard gray slate. Its use or meaning cannot be determined.

Figure 9 represents a stone ring $\frac{5}{8}$ of an inch in diameter, and probably intended for the finger. It is made of hard gray slate; is shaped like the usual plain gold ring, and is quite symmetrical.

Figure 10. Arrow-heads were found associated with nearly every ruin examined. They present a great variety of forms; some of the more striking of these are given in the figure. The materials used in their manufacture are principally the more beautiful varieties of obsidian, asper, and agate.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A NOTICE OF THE ANCIENT RUINS IN ARIZONA AND UTAH LYING ABOUT THE RIO SAN JUAN.

By W. H. Jackson.

In continuing the investigation, commenced last season, of the very interesting ruins scattered throughout the San Juan basin, I proceeded to Parrott City, a frontier mining-camp on La Plata River, where I procured the services of Harry Lee as guide and interpreter. Mr. E. A. Barber, naturalist and special correspondent of the New York Herald, was also of the party. Providing ourselves with the supplies which had been forwarded to this point via Tierra Amarilla, we started out late in July, journeying westwardly to that point on the Hovenweep from which we had turned back last year, and where we shall also resume our explorations.

The Hovenweep (a deserted valley) is a tributary of the McElmo, which, together with the wide-spreading arms of the Montezuma, drain into the San Juan all that portion of the country lying between the Mésa Verde and the Sierra Abajo, covering in the aggregate some two thousand five hundred square miles. Their labyrinthine cañons head close upon the Dolores on the north, and ramify the plateaus in every direction with an interminable series of deep, desolate gorges, and wide, barren valleys. There is not a living stream throughout this whole region. During the summer months water occurs in but very few places, generally in pockets, sometimes in springs, where the excess, if any, is soon swallowed by the hot and thirsty sands. The rainy season is in winter and the early spring months, when the water is more generously distributed, being then found in the many basins scattered over the bare tops of the mésas, as well as in the beds of the cañons, the lower temperature of the colder season preventing the rapid evaporation of summer and autumn weather. As a great proportion of the surface of this region is a bare bed of rock, with a soil in the lowlands nearly impervious to moisture, the winter showers soon gather their waters together in great floods in the main channels, and then, rushing down in a solid body, form those deep "washes" so characteristic of the country. But these torrents are short-lived, and it is only by noting the height of the drift-material lodged upon the trunks of the venerable cottonwoods bordering the banks that we can fully realize such great bodies of water ever having existed in so dusty a bed. Every cañon and valley has its corresponding wash, worn perpendicularly down through the dry, easily-eroded soil, forming circuitous but excellent pathways. In some valleys, where the drainage is considerable, these washes frequently attain a depth of from 30 to 40 feet, and are impassable for miles.

The intervening table-lands obtain a very nearly uniform height of 500 feet, running up to over 1,000 feet as we approach the Dolores divide. In the wider valleys the maximum is reached by successive steps, or benches, rising one back of the other, while in the narrow

cañons the ascent is more abrupt; the upper third of the escarpment being generally perpendicular, with the lower two-thirds composed of talus. Their summits and sides are usually clothed with a scrubby growth of piñon and juniper trees, increasing in density and size as we approach the divide on the north, while the valleys below sustain dense masses of sage-brush and greasewood, that, in some places, attain a height of from 10 to 12 feet. Vigorous, fresh-looking cottonwoods line the main channels, and are as deceptive to the thirsty traveler as a mirage. One may travel for miles in the parched bed of the wash at their feet, while overhead their wide-spreading branches cast a grateful shade, and yet not be able to find a drop of water anywhere in their vicinity.

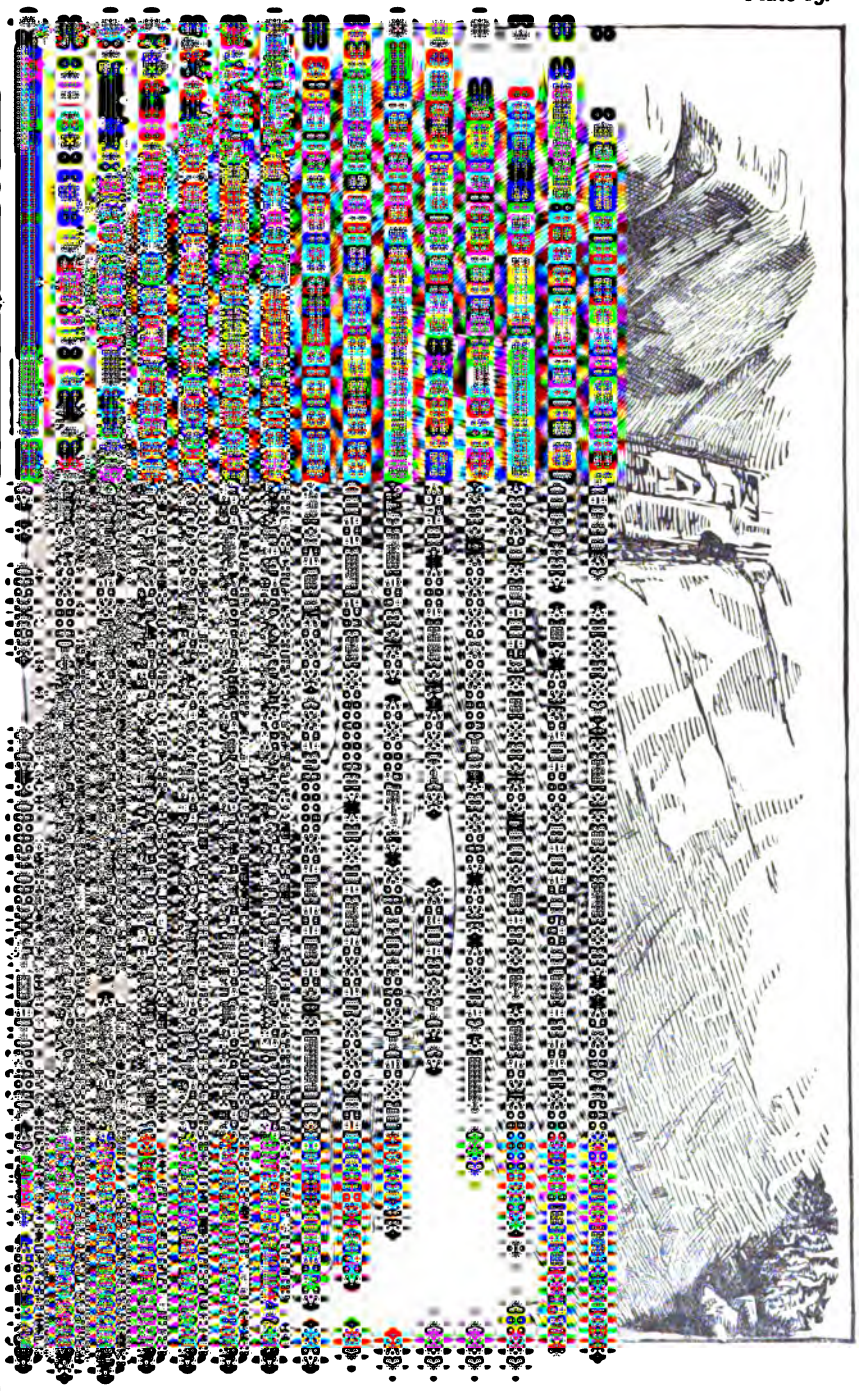
West of the Montezuma two or three small tributaries of the San Juan head from the southern face of the Sierra Abajo, and then comes Epsom Creek, rising among the plateaus farther to the west—so called from the water in one portion of its bed having the effect and tasting like that salt. For a distance of some twenty-five miles above its mouth the valley of this creek presents upon its eastern side a remarkable wall, some 400 feet in height, inaccessible throughout its whole length with the exception of one place where the Indians have made a way for themselves. It is caused by an immense fold in the sandstones, running north and south in a semicircular line, for some forty miles, and this valley has been eroded from that portion of it where the strata stood nearly perpendicular. On the west the beds sweep up in graceful curves to a nearly horizontal position, upon which isolated mésas rise up above the general level in bold relief against the sky.

The Rio San Juan drains all of this great interior basin, covering over twenty thousand square miles, as well as several great mountain masses bordering it nearly all around. It has at the mouth of the McElmo an average width of fifty yards, and a depth of from 4 to 6 feet; its current moving somewhat sluggishly in great sweeping curves that almost touch upon themselves again. The water is warm, and well freighted with the soil which it is continually undermining—a great contrast to the clear, ice-cold tributaries which give it existence. The bottoms are from three to five miles in width, and, bordering the stream, covered with dense growths of cottonwood and willows. The broad and fertile alluvial lands, well covered with grass, and the low sage-brush benches bordering them, will undoubtedly prove a rich agricultural possession at no distant day. Back of all, upon either hand, rise up the precipitous sandstone bluffs, picturesque in outline and color, that gradually close down upon the river until it is ingulfed in the great cañon commencing just below the mouth of the Rio De Chelly, and is then lost to all knowledge until it re-appears mingling its waters with those of the still more turbid and turbulent Colorado. South of the San Juan, the Rio De Chelly, coming in opposite the mouth of Epsom Creek, does not differ in its cañon character from those of the north. The bordering plateau, however, is more massive and less cut up by side cañons. The same aridity prevails throughout nearly its whole length.

Having thus superficially surveyed the region on which are to be found a vast number of prehistoric ruins, we will now return to the Hovenweep and examine, in such detail as our rapid reconnaissance will allow, the more prominent of the abundant remains.

Starting from the pueblo of the Hovenweep, described on page 30 of Bulletin No. 1, second series, we do not find in the immediate neighborhood any other ruins of importance; but a short distance down the

Plate 15.



cañon they begin to occur quite frequently. We observe first, on the left, the remains of a tower perched upon a rock, jutting out into the valley, beneath and about which were other ruins, evidently belonging to the tower. In the vicinity are other "rock-shelters," occurring upon either side of the cañon, some merely walled-up caves, while others are semicircular walls built out from the rock and protected overhead by an overhanging ledge.

Some seven miles from the pueblo, and about three above the McElmo, on the western side of the valley, is a jagged, butte-like promontory, of a brownish-yellow sand-rock, standing out from the mésa, upon the face of which are a number of benches and cave-like recesses. These have been built up and inclosed with neatly-laid walls, making six different houses or sets of rooms upon three benches, one above the other. Access was had from below, first by ascending a steep slope of *débris* for about 100 feet to the foot of the rock, where we find the first and largest of the houses. It is some 12 feet in length by 5 feet deep, divided midway into two rooms, but rendered somewhat indistinct by the falling-down of a portion of the rock back of it. The second bench was reached in the manner shown in Fig. 2, Plate 15, the little house there seen being the first of three strung along in a row. Above these were two other similar ones, very difficult to reach, the ledge upon which they stand projecting over the one beneath. The perfectly flat floor of the valley at the foot of the rock contained faint indications of having been occupied by buildings; and one of the curves of the wash, here some 10 feet in depth, in cutting away the soil disclosed a thin stratum of charcoal about 6 feet below the surface; one piece that we picked out being about 3 inches thick, and the earth about the mass in which it occurred was much burnt, as though the fire had been long continued. About a mile farther down we came to an expansion of the valley with a cañon opening in from the west. An examination up this for six miles failed in discovering any remains of stone buildings, but very numerous indications of probably adobe structures, or earthen foundations for wooden ones; in every instance circular, with a diameter of from 15 to 25 feet. A dozen such were found within three miles of each other. Fragments of pottery of excellent quality and neatly ornamented were very abundant.

Opposite the mouth of this cañon the mésa juts out prominently into the valley. Half-way up its face is a bench-like spur, upon which rests an almost perfectly rectangular block of sandstone fallen from the cliff above. It is 38 by 32 feet square and 20 feet high. The upper surface is entirely covered with the remains of a wall from 3 to 5 feet high, running around its outer edge; a diagonal line divides the interior into two nearly equal spaces, one of which is again subdivided into three smaller rooms, the passage between them formed by the dividing walls overlapping, their opposite ends being set off from each other about 20 inches, thus necessitating a zigzag course in passing from one to the other. At the foot of the south side of the rock, and directly beneath the subdivided half of it, there is a line of stone wall inclosing a space 40 feet square, the rock forming one side, with the center depressed a couple of feet below the surrounding level. In the right-hand corner of this inclosure, against the rock, are the ruins of another building 20 feet square; 10 feet above the base of the rock, and over this ruin, four holes have been drilled into it, six inches deep and four inches in diameter, serving evidently to support the roof of the building below and to afford a means of access to the rock above, a door-way in the surrounding wall being plainly indicated at that point.

Two miles farther down the McElmo comes in at nearly right angles from the east, and upon the point of the mésa included within the angle thus formed by the two cañons or valleys—we cannot call them streams—are a group of ruins similar to ones above, but much less regularly built. An interesting inscription occurs upon the under face of a large rock that supports a ruin, covering some 60 square feet of surface; animals resembling goats, lizards, human figures, and many hieroglyphicaly signs abound. While sketching these our attention was called to the top of the mésa by Mr. Holmes (who has accompanied us thus far with his division on his way to the San Juan, and who had ascended to the summit for the purpose of sketching,) to some very interesting remains he had discovered there.

The perpendicular scarp of the mésa ran around very regularly, 50 to 100 feet in height, the talus sloping down at a steep angle. On cave-like benches at the foot of the scarp, is a row of rock shelters, much ruined, in one of which was found a very perfect polished stone implement. Gaining the top with some difficulty, we found a perfectly flat surface, 100 yards in width by about 200 in length, separated from the main plateau by a narrow neck, across which a wall had been thrown, but now nearly leveled. Very nearly the entire space fenced in by this wall was covered by an extended series of small squares, formed by thin slabs of sand-rock set up edgewise. (Fig. 3, Plate 20.) All were uniformly about 3 by 5 feet square, arranged in rows, two and three deep, and adjusted to various points of the compass, but there were also a few circles disposed irregularly about the inclosed area, each about 20 feet in diameter, and formed of these same squares, leaving a circular space of 10 feet diameter in the center. These squares occur indiscriminately over the whole region that has come under our observation, upon the mésa tops and in the valleys, all of the same general shape and size, very seldom accompanied by even the faintest indication of a mound-like character, but nearly always in groups. We have always supposed them to be graves, but have not as yet found any evidence that would prove them such. Some that we excavated to a depth of 5 and 6 feet, into a solid earth that had never been disturbed, rewarded us with not the faintest vestige of any remains, excepting, in nearly every case, a thin scattered layer of bits of charcoal from 6 to 18 inches beneath the surface. In one instance, near the Mésa Verde, the upright slabs of rock which inclosed such a square were sunk 2 feet into the earth and projected 6 inches above it. In another, was found a mass of charred matter that promised to throw some light upon the subject, but a chemical analysis by Dr. Endlich proved it to be simply charred juniper-wood, without perceptible admixture of animal matter. In the present instance, as the soil was thin and sandy, in some places blown entirely off, leaving the bare bed-rock exposed, we excavated several of these with pick and shovel, there being only from 12 to 18 inches of earth to remove, but in no case finding anything more than the scattered charcoal spoken of above. In some, the earth was calcined, as though a fire had been made within them, while in others there was no vestige of a fire beyond the presence of the charcoal. The question very naturally arises as to whether they might not have been cremationists, a supposition that would have some appearance of likelihood, could we but find any trace of human remains among the bits of charred wood. Scattered over the whole surface of this mésa were a great many flint-chippings, from among which we picked up a number of very beautiful arrow-points. As the summit commands a wide sweep of country, it is not unlikely that sentries of old beguiled their tedious watch with arrow-making.

From the camp at the pueblo Mr. Chittenden, of Mr. Holmes's division, rode up the Hovenweep some eight miles, to where it divided equally into two branches, and upon the point between these forks he found the remains of a round tower, commanding an extended view down the main cañon. No other ruins were noticed.

The parties, under the guidance of Mr. Gardner, camped one night near the head of the Hovenweep, and found there an important group of ruins, described as follows by Mr. Adams:

"The first of these we met are situated at the upper edge of the side of the cañon, about one-third of the distance from the top, on a ledge about 300 feet long and 50 wide. On this small space were crowded some 40 houses, as well as we could judge from the ruins. The general plan of structure was circular, varying in size, but generally from 10 to 15 feet in diameter. The stone was dressed to three times the size of an ordinary brick and in the same shape. * * * The whole arrangement of the little town was for defense; perched up high above, on the summits of bowlders, were little watch-towers, which commanded the plateau above."

Between the Montezuma and the Hovenweep is a high plateau running north and south, from the San Juan to the Dolores; the southern portion a level sage-covered plain, while the northern is more undulating and covered with junipers and piñon pine. Upon this we found the remains of many circular towns, generally occupying slight eminences, and in but one or two cases, as far as we observed, were so entirely demolished that not one stone remained upon another. In one of these exceptions, about half the circumference only of a tower remained, 15 feet in height and of average masonry. Broken pottery was but sparingly scattered about, showing them not to have been occupied as much as the very similar remains in the valleys below. This mésa, averaging 500 feet in height above the surrounding country, does not contain a spring or drop of water, except such as may remain in the holes in the rocks after a shower. The soil is thin and sandy, blown off clean to the bed-rock in places, yet what there is is well grassed, and sage-brush flourishes luxuriantly. As cultivation was out of the question, and permanent residence improbable, it is very likely these towns were lookouts or places of refuge for the shepherds, who brought their sheep or goats up here to graze, just as the Navajos used to, and the Utes do at the present time. Rude huts of a later day are now found scattered over its surface, by the side of the washes where water would be likely to collect.

In traveling down the San Juan, from the mouth of the McElmo, there are not within the first ten or twelve miles any ruins that would claim attention upon a rapid reconnaissance. Indistinguishable mounds of earth frequently occur along the bottom-lands, surrounded by the ever-present fragments of pottery, showing them to be the sites or the remains of habitations; the quantity of pottery, domestic utensils, and arrow-points helping somewhat to determine the length of time they were occupied.

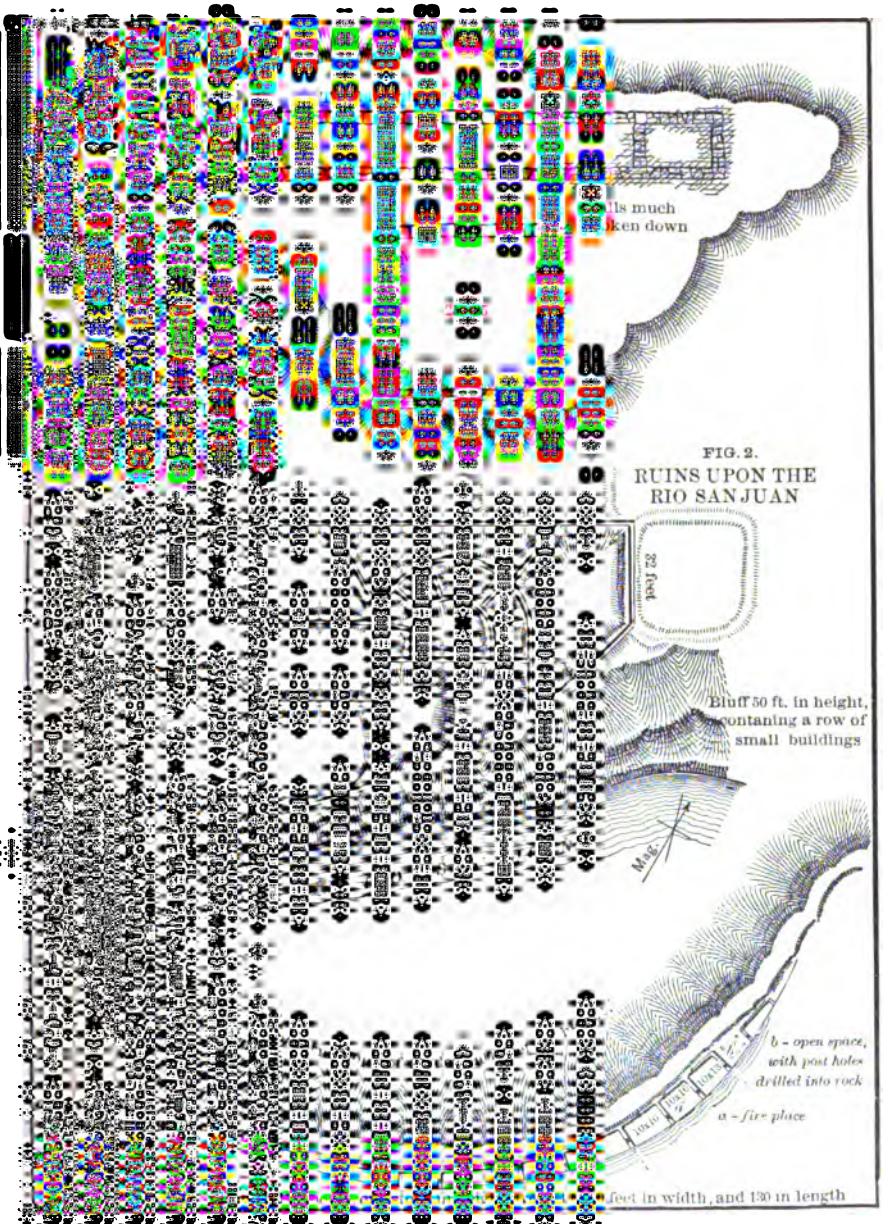
Crossing the mouth of the broad sandy wash of the Montezuma, that is here bordered with groves of brilliantly-green cottonwoods along its arid course, we pass about three miles below, and find camp under a grove of patriarchal trees within a well-grassed bend of the river. A wide gravelly bench, some 50 feet in height, and running back to the bluff line, rises up abruptly from the bottom-lands; a few rods below camp, the river in its meandering sweeps close to the foot of this bench, producing an almost perpendicular face. Upon the top of the bench at

this point, overlooking the river, are the ruins of a quadrangular structure of peculiar design.

Referring to the ground-plan, as shown in Fig. 2, Plate 16, we see that it is arranged very nearly at right angles to the river, its greatest depth on the left, where it runs back 120 feet; the front sweeps back in a diagonal line, so that the right-hand side is only 32 feet in depth. The back wall is 158 feet long, and at right angles to the two sides. In the center of the building, looking out upon the river, is an open space 75 feet wide, and averaging 40 feet in depth, its depressed center divided nearly equally by a ridge running through it at right angles to the river. We judged it to have been an open court, because there was not the least vestige of a wall in front, or on the ridge through the center, while upon the other three sides they were perfectly distinct; although it is difficult to explain why it should have been hollowed out in the manner shown in the plan. Back of this court is a series of seven apartments of equal size, springing in a perfect arch from the heavy wall facing the court, leaving a semicircular space in the center, 45 feet across its greatest diameter. Each one is 15 feet in length, and the same in width across its center, the walls somewhat irregular in thickness, but averaging 20 inches, compact, and well laid. On the left are three rooms extending across the whole width of the building, each averaging 45 by 40 feet square; on the right only one was discernible. Back of the circle, our impression was that the walls diverged in the manner shown in the plan, although there is so much confusion resulting from the heaping up of the *débris* that much must be left to conjecture. There is also a slight shadow of doubt in regard to the wall facing the river on the right; it is barely possible that it extended somewhat farther out, although there is here a steep inclination to the brink of the bluff, and that it has become entirely obliterated by its foundations giving way. The remains of the wall above, however, led us to believe that it had been originally built in the way it is shown in the plan. Extreme massiveness is indicated throughout the whole structure by the amount of *débris* about the line of the walls, forming long rounded mounds, 4 to 5 feet high, with the stone-work cropping out, 20 to 24 inches in thickness. Portions of the outer wall have fallen outward almost in one solid piece, the stones remaining spread out in much the same order they occupied in the standing wall. The stones were of fair size, but yet not so large but that one man could handle the largest of them. They were obtained from the neighboring bluff, and probably undressed, but broken into very nearly rectangular blocks, so that when carefully laid and dressed up with adobe cement they would have all the effect of dressed stone. Their extreme age, which has crumbled a great many into dust and rounded the asperities of all into shapeless bowlders, renders any conjecture upon this point somewhat uncertain. Where portions of the undisturbed wall did appear above the rubbish it showed a solid, well-constructed masonry. No indications whatever could be found of any passage-ways, nor could we expect to find any so near their base, for all of the apartments were probably entered by ladders, the same as in other buildings of this order that we have found in other localities.

Upon either side and back of this building were low, indefinite lines of earth, not more than 12 to 18 inches above the surrounding surface, inclosing areas from 40 to 60 feet in diameter, which were probably corrals for domesticated animals, the walls being composed of adobe or turf brought from the valley below, and which would, of course, wash down to a barely perceptible ridge.

Plate 16.


'ls much
iken down
FIG. 2.
RUINS UPON THE
RIO SAN JUAN
22 feet
Bluff 50 ft. in height,
containing a row of
small buildings
Mag.
b - open space,
with post holes
drilled into rock
a - fire place
feet in width, and 130 in length

In the face of the bluff immediately under this ruin, and upon a recessed bench situated about half-way between top and bottom, is a row of little "rock shelters." A stratum of a rotten shaly sandstone has been weathered or dug out, probably both, for a distance of 300 feet along the bluff, to a depth of about six feet, leaving a firm floor and a projecting ledge overhead, with just room enough to walk along without stooping. A continuous row of buildings occupied this bench, although most of them have tumbled into the river, and none have their front walls remaining. Door-ways through each of the dividing walls afforded access along the whole line. A few rods up stream, and in the same line of the bluff as the preceding, was another little niched cave-house, (figure 3, Plate 18,) 14 feet in length, 5 feet high at the center and 6 deep, divided into two equal apartments; a small square window, just large enough for one to crawl through, was placed midway in the wall of each half. We well might ask whether these little "cubby-holes" had ever been used as residences, or whether, as seems at first most likely, they might not simply be "caches," or merely temporary places of refuge, and while, no doubt, many of them are such, yet in the greater majority the evidences of use and the presence of long-continued fires, indicated by their smoke-blackened interiors, would prove them to have been quite constantly occupied. Among all dwellers in mud-plastered houses it is the practice to freshen up their habitations by repeated applications of clay, moistened to the proper consistency, and spread with the hands, the thickness of the coating depending upon its consistency. Every such application makes a building appear perfectly new, and many of the best-sheltered cave-houses have just this appearance, as though they were but just vacated.

A quarter of a mile back over the flat level bench, is a long narrow hill about 100 feet in height, commanding an extended view up and down the valley, upon the summit of which is one of the circular, mound-like inclosures which occur so frequently upon both the highlands and the lowlands. It evidently has some connection with the group below on the river's edge, for there are no other ruins within several miles.

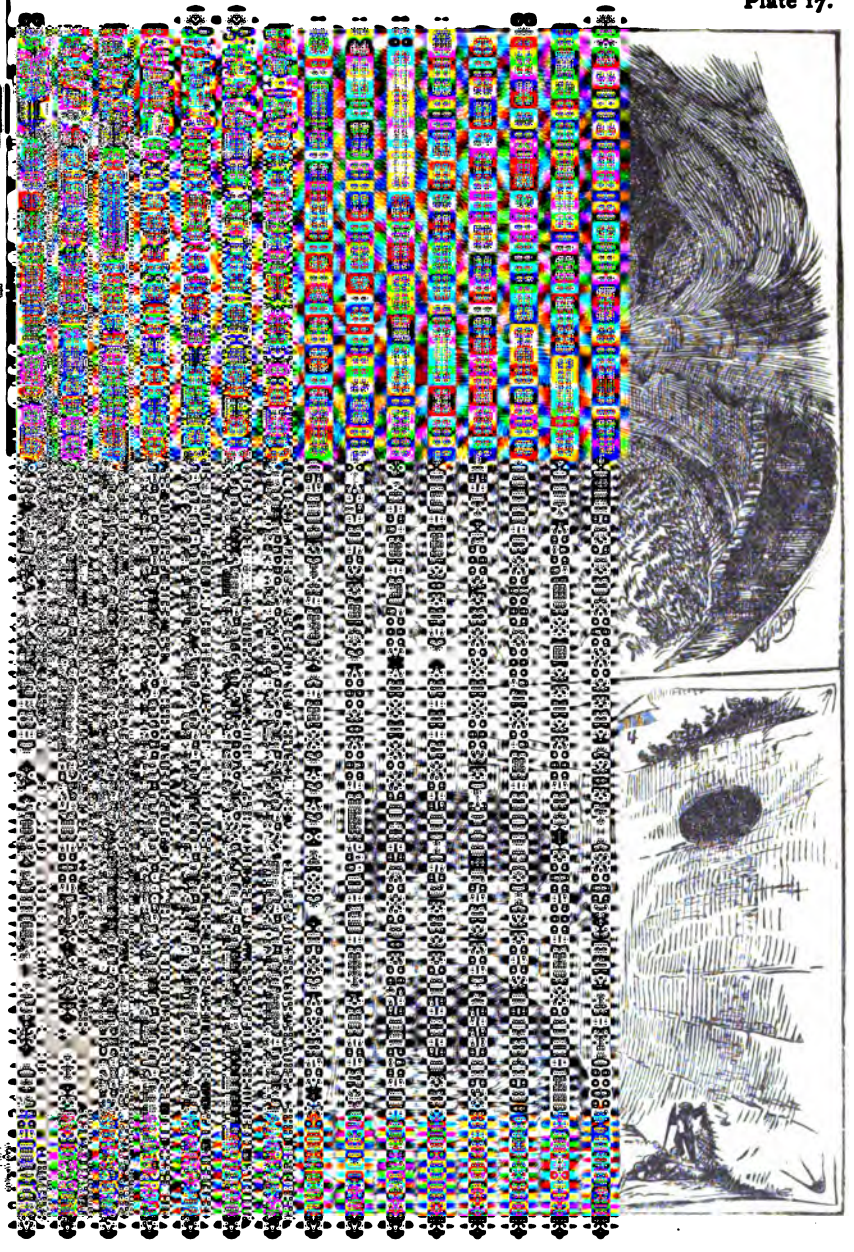
Continuing down the river, under the great bluffs which border it closely, we find many ruins of the "rock-shelter" kind occurring frequently in all sorts of positions, from the level of the valley to a height of over 100 feet, and from the smallest kind of a "cache," not larger than a bushel-basket, to buildings that sheltered several families. We illustrate one group in figure 4, of Plate 18, that consists of a row of three small houses built upon a ledge running horizontally along the perpendicular face of the bluff, about 60 feet above the trail immediately below it. The ledge was so narrow that the buildings occupied every available inch of its surface. As near as we could judge from below, each was about 5 feet wide and 10 long, with apertures through their end walls, and in the two first ones windows in the outer wall. No possible means of access were discernible, and if ladders were ever used they were taller than any of the trees available for the purpose that grow in this vicinity.

About twelve miles below the Montezuma we discovered, far away upon the opposite side of the river, a great circular cave, occupying very nearly the entire height of the bluff in which it occurred, and in which, by close inspection with the glass, we were enabled to make out a long line of masonry. Fording the river and approaching it we found that the bluff-line at this place was a little over 200 feet in height, the upper half a light-colored, firm, massive sandstone, and the lower a dark red and shaly variety. The opening of the cave is almost perfectly cir-

cular, 200 feet in diameter, divided equally between the two kinds of rocks, reaching, within a few feet, the top of the bluff above and the level of the valley below. It runs back in a semicircular sweep to a depth of 100 feet; the top is a perfect half dome, and the lower half only less so from the accumulation of *débris* and the thick brushy foliage, the cool dampness of its shadowed interior, where the sun never touches, favoring a luxuriant growth. A strata of harder rock across the central line of the cave has left a bench running around its entire half circle, upon which is built the row of buildings which caught our attention half a mile away. In figure 3, Plate 16, we have a plan of a horizontal section of the cave, showing the ledge and the manner of the disposition of the buildings upon it; in the drawing at the top of Plate 17, we have a view of them as seen from the opposite side of the cave.

It will be seen that the houses occupy the left hand or eastern half of the cave, for the reason, probably, that the ledge was wider on that side, and the wall back of it receded in such a manner as to give considerable additional room for the second floor, or for the upper part of the one-story rooms. It is about 50 feet from the outer edge in to the first building, a small structure 16 feet long, 3 feet wide at the outer end, and 4 at the opposite end; the walls, standing only four feet on the highest remaining corner, were nearly all tumbled in. Then came an open space 11 feet wide and 9 deep, that served probably as a sort of workshop. Four holes were drilled into the smooth rock floor, about 6 feet equidistantly apart, each from 6 to 10 inches deep and 5 in diameter, as perfectly round as though drilled by machinery. We can reasonably assume that these people were familiar with the art of weaving, and that it was here they worked at the loom, the drilled holes supporting its posts. At *b*, in this open space, are a number of grooves worn into the rock in various places, caused by the artificers of the little town in shaping and polishing their stone implements. The main building comes next, occupying the widest portion of the ledge, which gives an average width of 10 feet inside; it is 48 feet long outside, and 12 high, divided inside into 3 rooms, the first two 13½ feet each in length, and the third 16 feet, divided into two stories, the lower and upper 5 feet in height. The joist holes did not penetrate through the walls, being inserted about 6 inches, half the thickness. The beams rested upon the sloping back-wall, which receded far enough to make the upper rooms about square. Window-like apertures afforded communication between each room, all through the second story, excepting that which opened out to the back of the cave. There was also one window in each lower room, about 12 inches square, looking out towards the open country, and in the upper rooms several small apertures not more than 3 inches wide were pierced through the wall, hardly more than peep-holes. The walls of the large building continued back in an unbroken line 130 feet farther, with an average height of 8 feet, and divided into 11 apartments, with communicating apertures through all. The first room was 9½ feet wide, the others dwindling down gradually to only 4 feet in width at the other extremity. The rooms were of unequal length, the following being their inside measurements, commencing from the outer end, viz: 12½, 9½, 8, 7½, 9, 10, 8, 7, 7, 8, 31 feet; the ledge then runs along, gradually narrowing, 50 feet farther, where another wall occurs across it, after which it soon merges into the smooth wall of the cave. The first of these rooms had an aperture leading outwards large enough to crawl through; the wall around it had been broken away so that its exact size could not be determined; all the others, of which there were about two to each room, were mere peep-holes, about 3 inches in diameter, and

Plate 17.



generally pierced through the wall at a downward angle. No sign of either roofing or flooring material could be found in any of the rooms. Everything of that kind has been thoroughly burnt out or removed, so that not a vestige of wood-work remains. We cannot be positively certain that they had ever been roofed, the mild temperature of this region hardly necessitating any other covering than such as the ample dome of the cave itself offered. In the central room of the main building we found a circular basin-like depression, (*a*,) 30 inches across and 10 deep, that had served as a fire-place, being still filled with the ashes and cinders of aboriginal fires, the surrounding walls being blackened with smoke and soot. This room was undoubtedly the kitchen of the house. Some of the smaller rooms appear to have been used for the same purpose, the fires having been made in the corner against the back wall, the smoke escaping overhead. The masonry displayed in the construction of the walls is very creditable; a symmetrical curve is preserved throughout the whole line, and every portion perfectly plumb; the subdivisions are at right angles to the front. The stones employed are of the size used in all similar structures, and are roughly broken to a uniform size; more attention seems to have been paid to securing a smooth appearance upon the exterior than the interior surfaces, the clay cement being spread to a perfectly plane surface, something like a modern stucco finish. In many places, of course, this has peeled away, leaving the rough, ragged edges of the stones exposed. Inside some of the subdivisions that appear to have been less used than others, the impressions of the hands and even the delicate lines on the thumbs and fingers of the builders were plainly retained; in one or two cases a perfect mold of the whole inner surface of the hand was imprinted in the plastic cement. They were considerably smaller than our own hands, and were probably those of women or children. In the mortar between the stones several corn-cobs were found imbedded, and in other places the whole ear of corn had been pressed into the clay, leaving its impression; the ears were quite small, none more than 5 inches long. In the rubbish of the large house some small stone implements, rough indented pottery in fragments, and a few arrow-points were found. It is a wonder that anything is found, for it is more than likely that every house has been ransacked time after time by wandering bands of Utes and Navajos, who would search with keen eyes for any articles of use or ornament left after the first spoliation. The whole appearance of the place and its surroundings indicates that the family or little community who inhabited it were in good circumstances and the lords of the surrounding country. Looking out from one of their houses, with a great dome of solid rock overhead, that echoed and re-echoed every word uttered with marvelous distinctness, and all about a steep descent of 100 feet down to the broad fertile valleys, covered with waving fields of maize, the scattered groves of the majestic cottonwood, and the meanderings of the Rio San Juan, these old people, whom even the imagination can hardly clothe with reality, must have felt a sense of security that even the incursions of their barbarian foes could hardly have disturbed.

Soon after leaving the Casa del Éco, as we named the last ruins, our trail bore away to the right upon the plateaus, which now begin to encroach too closely upon the river to permit us to follow its course, and we come under a second line of bluffs, which were gradually surmounted also. The evidences of former occupation continue as numerous as ever, finding shape principally in cave-houses, all too near alike to bear much further repetition. A novel feature at one point is shown in Fig. 5, Plate 18, where we have a smooth bluff of cream-colored sandstone

about 150 feet high, with hardly a seam on its surface, over which has been cut a series of steps. Upon the pile of *débris* at the left are the ruins of some structure that had been built just beneath the line of foot-steps, and was evidently placed there as an approach to them, as they only came down to within about 12 feet of the bottom. The large slab of rock lying against the bluff on the right was separated from it about 3 feet at the base, making a long, narrow passage-way, that could also be reached through the small opening between the rocks on the right; from within this place it was not difficult to reach the round bowlder lodged above, from which starts another line of steps. The surface of the rock has worn away to such an extent as to nearly entirely obliterate some of the holes, rendering ascent, at the present time, impossible; and as the bluff was inaccessible for two or three miles upon either side, we did not reach the top or see from below any evidences of building.

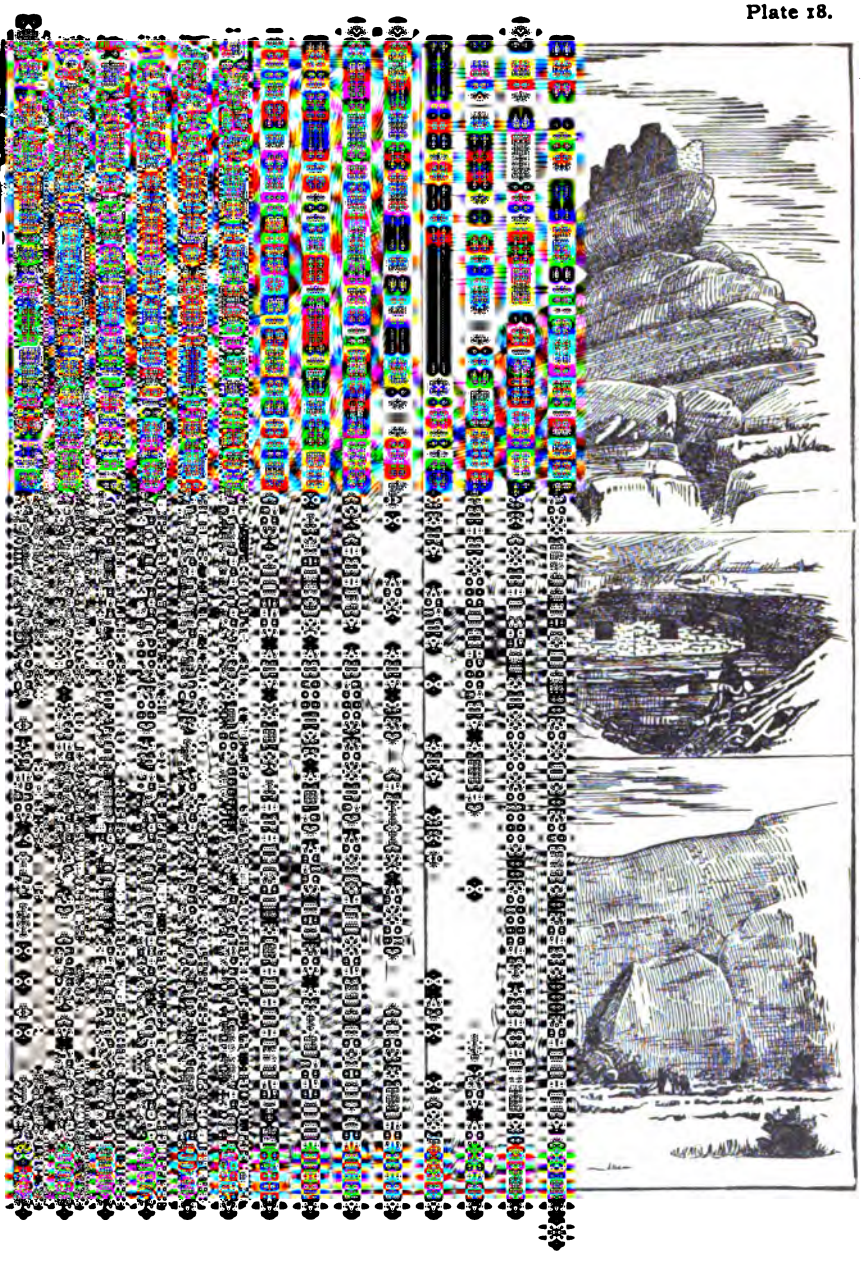
Our trail over the bare plateau finally brought us down to the San Juan again, just at the junction of Epsom Creek with it, and but a short distance above the mouth of the Rio De Chelly, where we found a pleasant park-like valley, about a mile in length, bordered by groves of cottonwood and willows. The beds of Epsom Creek and the Rio De Chelly were both perfectly dry, like all the tributaries of San Juan west of the Mancos, although in the latter were indications of occasional flooding, some of the deeper pockets retaining shallow pools of a very red, muddy water. Upon every side—except where the broad valley of Epsom Creek opened northwardly, with the deep blue summits of the Sierra Abajo appearing in the vista—steep rugged bluffs of bare red rock rose up, weathering occasionally into sharp needle-like pinnacles, discernible for long distances in any direction. The San Juan emerged from a considerable cañon at the head of this little valley but to sink into a still greater one below. The low stage of water encouraged us to explore this lower cañon for a short distance, which we could readily do upon our riding-animals, the indefatigable little Mexico, our pack-mule, carrying the photographic instruments. We penetrated its exceedingly tortuous course about ten miles, meeting no serious obstruction, and it is likely could have gone much farther. The walls rose abruptly, generally perpendicularly, upon either side, from 1,000 to 2,000 feet in height, but always with a bench at the bottom bordering the stream, covered with a rough talus. Former floods and the drifting sands from the plateau above have filled up the interstices in the rocky mass, smoothing the way over them very considerably.

In the walls of the cañon of the Chelly, where it opens into the park, are several great circular caves, averaging 100 feet in diameter, in which were the remains of walls and houses, but all very much dilapidated. Upon a ledge on the opposite side of the cañon was a row of four houses, not easily reached, one of which still retained a roof; and in another case, a shelter was formed by inclining a row of sticks across the opening of the cave, with the outside thickly plastered with clay. It had every appearance of being a more recent structure, yet it was in the midst of much older-looking ones, and in an almost, if not quite, inaccessible position.

Over the level surface of the valley the older form of ruins, indicated principally by broken pottery, occurred in several places, and also, on a bench bordering the San Juan, just above Epsom Creek, were a number of small squares arranged in circles, that we have heretofore assumed to be places of sepulture.

In going southward, up the Chelly, we find it necessary to avoid the cañons and make a detour to the right, crossing a rugged depression in

Plate 18.



the line of bluffs, to the valley of a small tributary, then over another divide across the upturned edges of the great fold spoken of in the first part of this article, to quite an expansion of the valley of the Chelly, about one mile square, covered with sage-brush and drifted sand, on the upper or right-hand side of which we are fortunate enough to find two springs of cool, fresh water, a most delicious luxury where the temperature of the water of the San Juan was 80 degrees, and the coldest to be had, and the temperature of the atmosphere away up in the hundreds during the day-time.

The surface of this valley, or small plain, contains indications of old ruins, about which we picked up many arrows, knives, and other stone implements, with the ever-present pottery. The wash of the Chelly skirts one side of the valley, with perpendicular bluffs 200 to 400 feet high, closely bordering its other bank. Above and below the opposite bluffs rise up again, throwing the wash into deep cañons. An examination of the exceedingly tortuous course of the wash and its accompanying bluff-line for a distance of 5 miles up and down revealed but one ruin (Plate 19), a very important and interesting one, however.

This cave-town occurs in a great bend of the encircling line of bluffs, where the wash makes a wide detour, perched upon a recessed bench about 70 feet above the valley, and overhung by a solid wall of massive sandstone extending up over 200 feet farther. The left-hand side of the bench supporting the buildings sweeps back in a sharp curve about 80 feet under the bluff, and then gradually comes to the front again until, on the extreme right hand, the buildings are built upon a mass of *débris*, but partially protected overhead. The total length over the solidly-built portion of the town is 545 feet, with a greater width in no place of more than 40 feet. There are somewhere in the neighborhood of 75 rooms upon the ground-plan, with some uncertainty existing as to many of the subdivisions on the right hand in the vicinity of *d* and *e*; but in the cave-built portion every apartment was distinctly marked. Midway in the town is a circular room of heavily and solidly built masonry, that was probably intended for an *estufa* or council-hall; that is, if we can reasonably assume any similarity in the methods of building or worship to those of the Pueblos of New Mexico. Starting from this *estufa* is a narrow passage running back of the line of houses on the left to the two-story group, *a*, where it ends abruptly, further access being had through the back row of rooms, or over the roofs of the lower front row, probably the latter, for it is likely that these roofs served as a platform from which to enter the rooms back of it. At the extreme end a still higher ledge occurs, with the overhanging wall coming down close over it, its outer edge inclosed by a wall, and a little store-room in its farther corner; it was reserved, probably, as an out-door working-room. All the buildings of this half are of one story, with the exception of the group *a*, the residence probably of the chief or of some other important family in the community. The rooms just back of it are the store-rooms of the family, where the corn and squashes were put away for the winter's consumption. At the place marked *b*, near these store-rooms, there are two half-round inclosures of stone-work, that are very likely the remains of small reservoirs or springs. The rock back of them is dug out beneath, and had, even in the dry season, when we were there, a damp appearance, as though water was not far removed, and might easily be coaxed to the surface. The front line of wall of this left side of the town is built upon a steep angle of smooth rock, with the interior of the apartments filled up with earth so as to make their floors level, bringing them a little

below the passage-way. In two or three instances, as shown in the plan, the front wall has given way, precipitating all but the back wall to the bottom of the cliffs. Holes have been drilled into the rock in a few places beneath the walls, evidently to assist in retaining them in their places.

The whole front of this portion of the town is without an aperture, save very small windows, and is perfectly inaccessible, both from the solidity of the wall and the precipitous nature of the foundation-rock beneath it. Admittance was probably gained from near the circular building in the center, by ladders or any other well-guarded approach over the rocks.

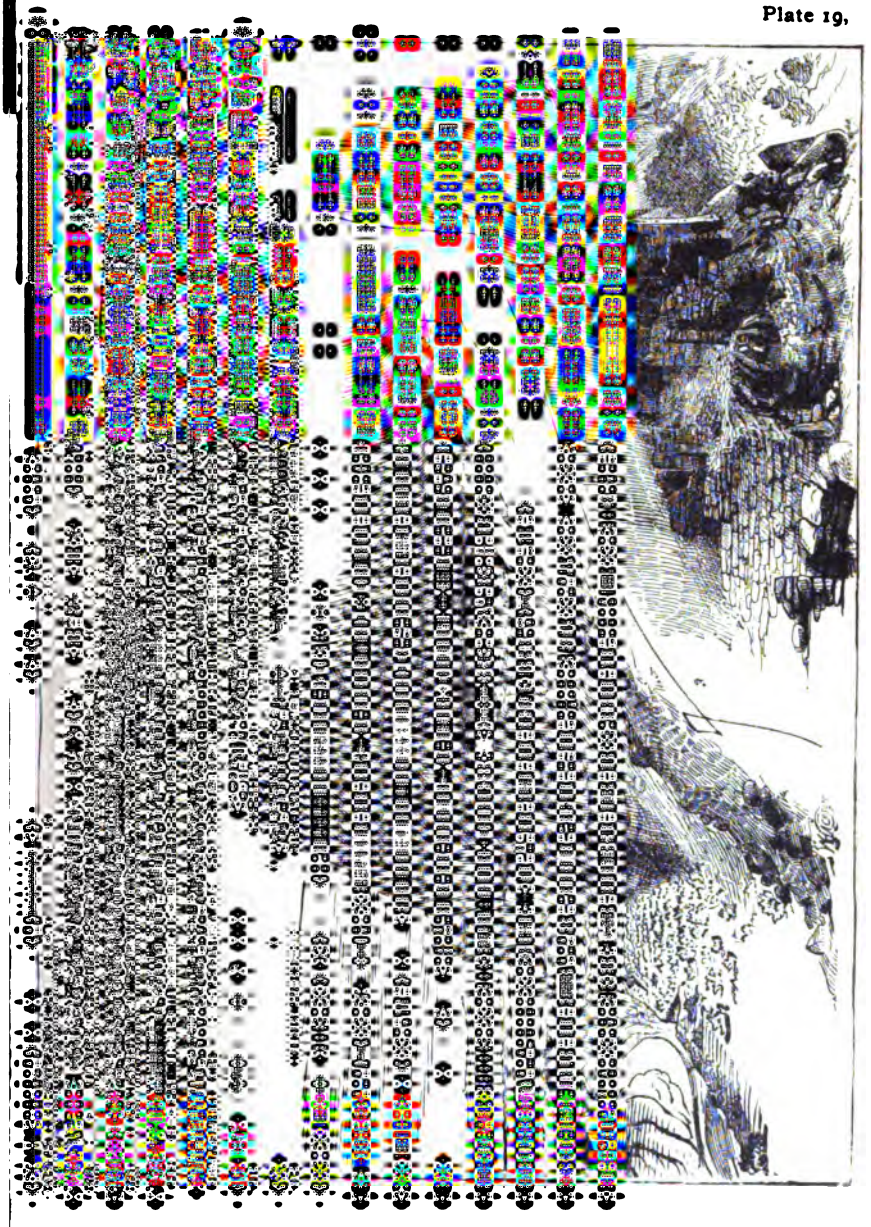
In Fig. 3 of the same plate we have a view of the other half of the town. From the *estufa* we have to climb up about 8 feet, reaching a narrow ledge that starts out from the bluff; from here to the farther end the buildings are built irregularly over the uneven surface of rocky *débris*, each house conforming to the irregularities by which it is surrounded, but all presenting the general arrangement of a cluster about a central court, as at *d* and *e*, that served, in all probability, as corrals for their domestic animals. In some places near these corrals the under surface has broken away, disclosing a solidly-packed bed of old manure, very nearly resolved back into dust again, and through which were scattered twigs of willow and sticks of cedar. Some of the rooms are quite large, from 15 to 25 feet in length; the very small rooms surrounding them were probably for storage, and in some cases seem to have answered the purpose of fire-places, as at *f*, for baking pottery, very likely. None of these buildings, as far as we could discover, were of more than one story in height. All the door-ways or windows opened from within the courts or corrals, and were unusually large, reaching in some cases the whole height of the wall. The front line was so broken down that it was impossible to tell to what extent it was accessible, although we may reasonably infer that it was not so, with the exception, perhaps, of a way for themselves and their animals. The bluff itself was easy to ascend, being composed of large rocks filled up with smaller *débris*.

In their construction these buildings differ from any we have yet met, in the thickness, or rather thinness, of their walls, being very seldom more than a foot, and more frequently between that and six inches thick. The stones of which they are built are in long thin slabs, trimmed down roughly to the required size and laid in an abundance of adobe mortar. In most of the rooms, both the inside and outside have been smoothly plastered over with clay, and, where protected overhead, still retain that coating in fair preservation.

A few rods to the right is another smaller recessed bench, upon which are built two small houses, each about ten feet square, and one with its roof still entire. The approach from below is a smooth, rocky surface, so steep as to be almost impossible to ascend, with no remains of any other easier method of getting up.

At the foot of the bluff beneath that portion of the ruin marked *d*, in the ground-plan, a low bench rises about ten feet above the surrounding valley, upon which are indications of old buildings and of other remains—our so-called burial places. Chipped flint work was plentiful, as we found a number of very beautiful specimens of arrow-points, perforators, knives, and some domestic utensils. In a mass of *débris* at the foot of the two-story tower, seven large earthen pots of rough indented ware were found imbedded in the soil and filled with earth. They were too fragile to admit of transportation upon pack-animals, so

Plate 19,



we put them carefully by for future investigators. In the rubbish at the extreme right, a handsome little jug or vase (see Fig. 5, Plate 21) was found, lacking only its handle. A careful search through the very thick deposits of *débris* would undoubtedly reveal many treasures, and we felt many regrets that we could not consistently devote a number of days to the pleasant undertaking. We can only expect to skim the surface, leaving to others hereafter the more satisfactory duty of exhausting each subject in detail.

In progressing southward we again find it necessary to climb the steep bluffs bordering the Chelly, here so tortuous and walled up as to be impracticable, if not impassable. Once on top, however, we made our way with comparative ease over great dunes of a very fine, yellowish white sand, packed so solidly as to inconvenience the animals but very little; but much the greater part of the way is over a solid floor of bare, nearly white, sandstone, rising into occasional dome-shaped hillocks, and furrowed by shallow ravines. Sage-brush, juniper, and piñon trees were scattered plentifully over the whole region, affording the only relief to an otherwise perfectly barren desert. Traveling thus over this trackless waste, we reach in about fifteen or twenty miles the bare red plains of the famous so-called diamond-fields of Arizona. Beautiful garnets were found scattered plentifully over the whole region, but they could not tempt us to linger, for the sun beat down upon its arid surface with such an intensity that but for the extreme dryness and salubrity of the atmosphere it would have prostrated anything but a salamander.

After crossing this plain we came suddenly upon a side cañon running across our course, seemingly a mere gash in the rocky plateau, down into which we were fortunate enough to find a practicable way for ourselves and animals. But what a contrast! A smooth sward of grass, and thick patches of the tall reedy kind peculiar to damp localities, made a change grateful to both man and beast. Continuing down this cañon—which has, in consequence of its inviting appearance, been called the Cañon Bonito Chiquito—a couple of miles brings us to the wash of the Chelly again, bordered with groves of fine old cottonwoods, but its bed, in which were pools of clear water, was so deep as to be almost inaccessible. A band of wandering Navajos just before us, with large flocks of sheep, had made a way down, however, that we found practicable.

An after-investigation revealed the presence of water in large artificial reservoirs, or tanks, in the cañon Bonito, just above where we entered it first, about which are grouped a number of old ruins. This has been a favorite Indian wintering-ground, so that the ruins here have been much modified by their occupation.

Two miles down the cañon of the Chelly we found the house shown in Fig. 1, Plate 15. Its situation is very similar to that of the town shown in Plate 19, but is overhung by a much less height of the impending bluff. It was reached from the valley by a series of steps cut into the rock, but now so weathered away as to be impracticable. It is accessible now by way of the ledge running to the left from the house, some 10 or 12 rods in length, but affording a very narrow and precarious footing. At the time of occupancy this was walled across, with possibly a way for getting over or around, for this ledge communicated directly with the plateau above, where there are the remains of what was possibly a corral.

The house consists of two stories, 20 feet in height, built against the sloping back wall of the bluff; the lower story is 18 by 10 feet square, divided into two rooms, one slightly smaller than the other, with a com-

municating door between, and a large door opening outward from the larger one. The upper floor appears to have been all in one room, with one large window facing outward, and much smaller ones in the side walls. Extensions existed upon either side, and also some kind of structure in front, probably a sort of platform-house, covering the lower door-way. To the right the ledge grows narrower, and gradually merges into the perpendicular bluff; 40 feet from the house, on this ledge, are the remains of a wall across it. About 20 rods above, at the foot of the bluff, there is a deep natural reservoir of water, formed by the accumulated rains upon the plateau above pouring over the rocks and scooping out a basin 30 feet in diameter and fully as deep, that seems to retain a perpetual supply of water.

Near our camp, just at the junction of the two cañons, and on the flat surface of the sage-covered valley, were a row of small squares marked out by large stones set upright, such as have been already described. In this case they were of such careful construction and size as to encourage us to dig into them to a considerable depth. Beyond the scattered bits of charcoal, very sparingly deposited in this instance, however, nothing was found.

Five miles above the cañon Bonito, the Chelly expands into a wide valley that extends, with slight interruptions, to the foot of the cañon De Chelly, at the northern end of the Tunicha Mountains. It is bordered by low but abrupt sandstone bluffs, which have been broken into isolated monuments in some places, and stand like huge sentinels upon either hand, as if to warn the traveler from the desolation surrounding him. Although the bluffs contain numerous great circular caves, favorite building-places of the ancient builders, yet we find only two or three ruins of that kind, and only in the lower end of the valley, the last we noticed being about eight miles above the cañon Bonito. This was the largest and most important one in this vicinity, occupying a large circular cave very similar to the one of the San Juan, divided into twelve or fifteen rooms, with a large corral or court, and an elevated bench to one side, with a low wall running around its front edge. This had been occupied by the Navajos for corraling their sheep.

Over the broad, flat valley, sage-covered, sandy, and monotonous, and through which the wide shallow wash meandered from side to side, we found frequent indications of its former occupancy by the old people whom we have been following up, extending southward until lost in the cultivated region about the head of the valley. There were no more remains of stone-built houses, nor the slightest sign of one; all were probably of adobe, the only clew in many cases being simply a slight mound with considerable quantities of broken pottery surrounding it. Eight miles up the cañon De Chelly are the ruins of a cave-town very much like the one described, (Plate II,) but much smaller, and with a ruined mass of houses at the foot of the bluffs below the cave-like bench.* About the head of the valley the Navajo Indians have several hundred acres, in the aggregate, of corn, pumpkins, and melons under cultivation, taking advantage of the water which comes down thus far from the mountains to the east. From here our trail to the Moqui settlements branched off in a southwesterly direction to a low divide under the southern end of the Mésa Vaca, where it turned nearly south and hardly deviated from a bee-line for a distance of nearly 40 miles to Tegua, the nearest of the Moquis towns.

We will not now stop to discuss the question as to what connection may have existed between the ancient builders of the San Juan and the

* Simpson's report.

present semi-civilized people known as the Moquis, but return to the mouth of Epsom Creek and describe the many curious remains found north of the San Juan, all of which bear some relationship to those of the Hovenweep already noticed.

Fifteen miles up Epsom Creek a side cañon comes in from the left, down which trickles a scanty stream of brackish water with the peculiarity of taste and action which has given the name to the whole valley. Camping here, we extended our observations up this lateral cañon some 8 or 10 miles in quest of ruins, and found them numerous enough to satisfy our most earnest desire, although not of the importance of the greater ones of the San Juan and De Chelly. All were of the small cave kind, mostly mere "cubby-holes," but so smoke-blackened inside and showing other marks of use as to convince us they had been long occupied but not during any comparatively recent period. In the generality of cases they were on small benches or in shallow caves situated near the bed of the stream, but the farther up we went the higher they were built. In one instance a bluff several hundred feet in height contains half a dozen small houses sandwiched in its various strata, the highest being up 150 feet, each of but one room, and one of them a perfect specimen of adobe-plastered masonry, hardly a crack appearing upon its smoothly-stuccoed surface. A short distance up from the entrance to the cañon a square tower (Fig. 2, Plate 18) has been built upon a commanding point of the mésa, and in a position, so far as any means at our command are concerned, perfectly inaccessible. The stones of which it is composed are of a very nearly uniform size, more so than in any of the buildings we have seen west of the Hovenweep.

Upon the opposite side of the main Epsom Creek Valley, and on top of the high bluffs of sandstone which border it for nearly its whole length, we found some cave-houses in a most singularly out-of-the-way place—in the very last place in the world where one would expect to find them. Scaling the bluff at the very imminent risk of our necks, we came suddenly upon a broad open cave, near the top, containing the usual style of stone-built and mud-plastered houses, divided into four or five apartments, of just the size and number that would be required by an ordinary family of eight or ten persons. Farther up, on top of the bluff, we found the remains of a circular tower 40 feet in diameter, and very old, the stones all crumbled, rounded, and moss-covered. Near by were remains of two other cave-habitations.

A few miles farther up the Epsom Valley, passing a number of old ruins hardly worthy of mention, we came upon an important group that was evidently the center of the surrounding population—a place of worship or of general congregation—an aboriginal shire-town.

It lay upon both sides of a small, dry ravine, some 20 or 30 rods back from the bed of the creek, and consisted of a main rectangular mass, 60 by 100 feet square, occupying quite an elevation, dominating all the others. Just below it, and close upon the edge of the ravine, was a round tower 25 feet in diameter; and 75 feet below that, and also close to the ravine. was a square building 20 feet across, nearly obscured by a thicket of piñon-trees growing about it. On the opposite bank were two small round towers, each 15 feet in diameter, with two oblong structures between, 12 by 15 feet square; at right angles to these four, which were arranged in a straight line, another square building occurred, the same size as the one just opposite on the other bank. Portions of the walls of the towers remained, and a few courses of stone in the walls of the smaller square buildings, but in the large ruin the walls were merely indicated by great mounds of crumbling rock, with the subdivisions distinctly marked however, into four rectangular apartments. A short

distance above, plenty of water was found in the bed of the creek; fine large cottonwoods bordered the stream, and the broad fertile valley seemed a far more desirable place of residence than the forbidding desolation of the Chelly.

About thirty miles from the San Juan we left Epsom Creek, and stopped for a night at the head of the cañons which run between it and the Montezuma. We were in the midst of quite a thickly-settled, ancient population, the ruins of their habitations consisting almost entirely of the kind just described—low, rectangular mounds, so completely destroyed as not to leave one stone upon another, yet accompanied always by an abundance of the same kind of pottery we have found so universally distributed over other localities. Not the slightest difference can be detected in its general quality, nor can any one style of manufacture or ornamentation be said to be peculiar to any one district or group of ancient habitations. It is the same with arrow-points and like work, and with the similarities in building; although covering two different periods of their existence, it carries the conviction to us that they were all one and the same people, scattered in families and communities throughout the valleys and cañons.

After leaving this last group of ruins, all traces of them suddenly ceased, and in the four or five days spent in the examination of the country upon the southern, eastern, and northern flanks of the Sierra Abajo, not a single vestige was found; and this in without exception, the most pleasant spot we have touched since leaving La Plata. Clear and cold mountain-streams ripple down through ravines overhung by groves of willow, maple, and quaking-asp, with splendid oaks and stately pines scattered over the uplands, and an abundance of rich, nutritious grass everywhere, that our poor, half-starved animals knew well how to appreciate. The black-tail deer and grouse were in goodly numbers, starting up from under our very noses, and leading our hunters many a long chase.

Leaving half of our little party of six, and all the animals but those we rode and the trusty Mex. with the apparatus, we made our way down through the deep and narrow cañons that lead from the plateau country into the great basin that lies between the Sierra Abajo and the Sierra La Sal, and spent two days in the examination of its arid surface, covered with monumental rocks and ridges, but without coming across so much as a piece of pottery or an arrow-point.

Turning our backs upon the Abajo Peaks, we struck out northeasterly over the plateau, but soon finding a trail bearing southeast, followed it until we saw that it was likely to continue some time upon the plateau, when we branched off to the left, and in a short distance came upon the very brink of the deep cañon of the Montezuma, one of the far-reaching arms of the main wash and valley farther east. Winding our way among rocks and scrubby piñons, we almost literally tumbled down the precipitous descent of 1,500 feet, to a narrow bottom, walled in first by a broad belt of massive white sandstone, rising almost perpendicularly from 20 to 50 feet above the valley; above that the dark red and shaly sand-rocks rose up in receding benches 1,000 feet to a broad tablet of white sandstone on top, so high up that it seemed to shut out all the world and to leave us as engulfed in the bosom of the earth. A narrow but deep "wash" meandered from side to side, containing just a few scattered pools of stagnant water, while dense thickets of oak brush, thickly interwoven with vines, rendered progress anything but pleasant.

We had gone but a few rods before we commenced picking up pieces of pottery and meeting other evidences of occupation; within three

miles a cave-shelter appeared, and then as the valley widened it was dotted in many places with mounds thickly strewn over with the ever-accompanying ceramic handiwork of the ancient people in whose footsteps we are following, and occurring so frequently and of such extent as to excite astonishment at the numbers this narrow valley supported. The line is so sharply drawn that in an hour's ride all traces of any ruins are lost; and there is not so much as a piece of pottery to show that these people had ever extended their residence beyond the limits of their cañon.

Soon other cave-dwellings appear, most of them little walled-up circular orifices in the rock, generally inaccessible, but many were approached by steps, or rather small holes cut in in such a manner as to enable the climber to ascend the rock as by a ladder. Examples of these kinds of ruins are shown in Figs. 1 and 4 of Plate 17, each about 40 feet above the valley, the first perfectly inaccessible and without the least sign of the original method of reaching it; in the other one the walls once closing it have been pushed down so that only traces of them remain; the steps leading up, however, show it to have been considerably used; they are now so worn down by the disintegrating influences of time as to no longer answer their purpose.

Throughout this cañon we find frequent examples of the footsteps cut in the rock, in the generality of cases being simply a way of scaling the smooth, nearly perpendicular wall of sandstone, which hems in the cañon on both sides for twelve or fifteen miles; probably a ready mode of escape up the bluff should enemies appear.

The cliff and cave dwellings, very small habitations, seldom larger than the one in Fig. 2, Plate 15, appear to occur in groups, not always in connection with the old valley ruins, but rather to alternate in succession as we progress down the cañon.

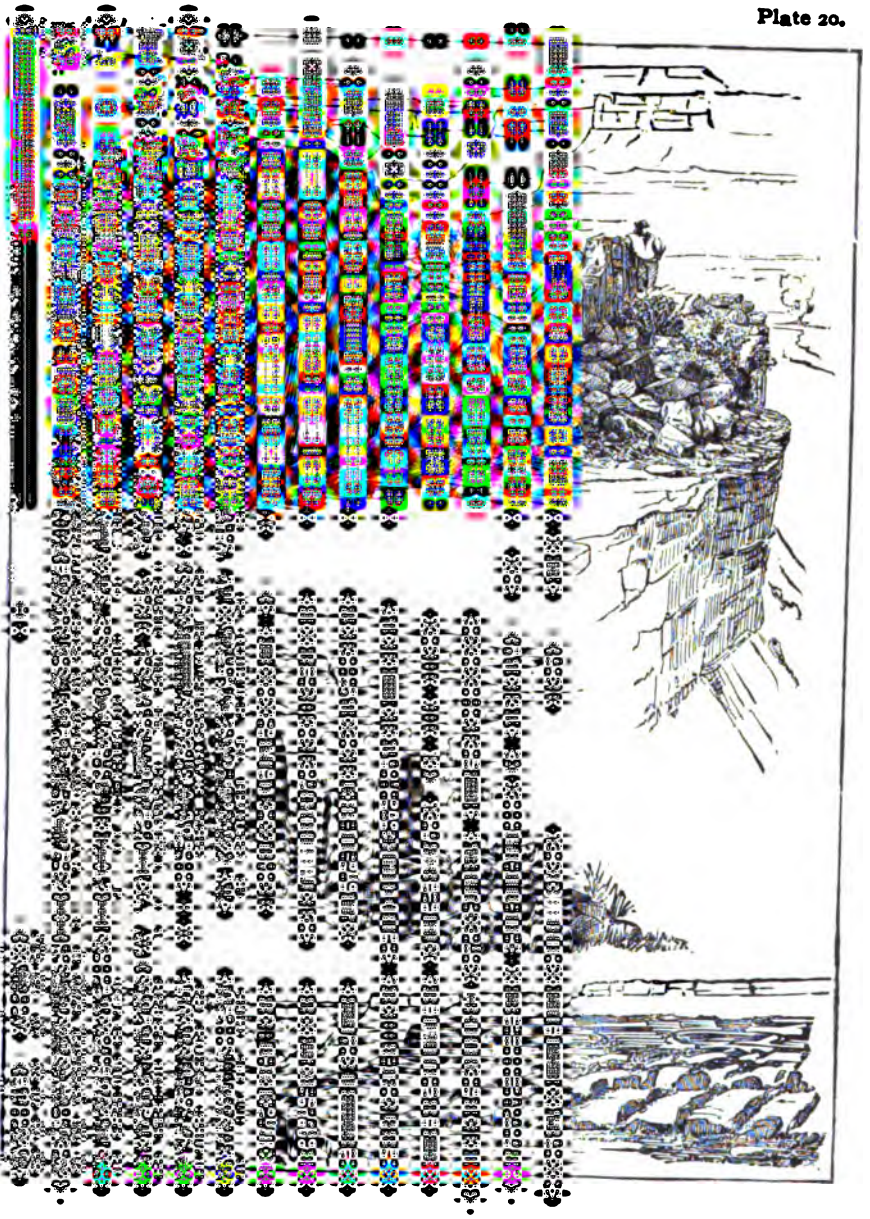
In one of the cave-dwellings, Fig. 3, Plate 17, perfectly black with long-continued smokes inside, and bearing other marks of long use, we found the complete skeleton of a human being; the remains, as afterward determined, of a young man somewhat under a medium size. The excrement of small animals, dust, and other rubbish filled the floor of the little house a foot deep, nearly burying the scattered bones; with them are the shreds of a woolen blanket, woven in long stripes of black and white, just such as the Navajos and Moquis make at the present time. It is likely that the remains are those of a Navajo, a people who occupied all this country up to within a short time, within the remembrance of the older persons, and who were driven beyond the San Juan by the onslaughts of the aggressive Utes.

After traveling about 20 miles from our starting-point at the foot of the mountains, half of the way in the cañon, we camped at the intersection of a large cañon coming in from the west, traversed by a large, well traveled Indian trail, that continued on down, probably the same one we had crossed earlier in the day. At this point the bottoms widened out to 200 to 300 yards in width, and are literally covered with ruins, evidently those of an extensive settlement or community, although at the present time water was so scarce—not being able to find a drop within a radius of six miles—that we were compelled to make a dry camp. The ruins consist entirely of great solid mounds of rocky *debris*, piled up in rectangular masses, covered with earth and a brush-growth, bearing every indication of extreme age; just how old is about as impossible to tell as to say how old the rocks of this cañon are. This group is a mile in length, in the middle of the valley-space, and upon both sides of the wash. Each separate building would cover

a space, generally, of 100 feet square; they are seldom subdivided into more than two or four apartments. Relics were abundant, broken pottery and arrow-points being especially plenty, and of excellent quality; at one place, where the wash had partially undermined the foundations of one of the large buildings, it exposed a wall of regularly-laid masonry extending down six feet beneath the superincumbent *débris* to the old floor-level, covered with ashes and the remains of half-charred sticks of juniper. From this rubbish a fine example of a stone ax, about the size of one's hand, was found, with a smooth and sharp-cutting edge, formed by grinding it down to an acute angle; its head was roughly chipped to the required shape for binding on a handle. At another point a small earthen bowl, of the superior ware characteristic of the people, was found entire. No special burial-places were observed, but a number of bones of the lower extremities were unearthed at the edge of the wash, without any stone-work above them. There were no cave-dwellings in the neighborhood of this group, but two or three miles below several occurred, one of which is built in a huge niche in the solid wall of the cañon, with its floor level with the valley. (See Fig. 2, Plate 17.)

From the last camp the cañon expanded into occasional valleys from 500 to 800 yards across, and then contracting again to a mere narrow passage, but still all shut in by the high escarpment of the mesa. From either side long narrow tongues or promontories extended out 100 yards, and from 20 to 100 feet high, sometimes connected with the main wall by a mere comb or wall of rock, its extremity, however, spreading out to an irregularly oval shape. In the valleys are occasional isolated mesas, the remnants, probably, of former promontories, left here by the great erosive powers which channeled out these cañons. Within a distance of 15 miles there are some sixteen or eighteen of these promontories and isolated mesas, varying in height, and every one of them covered with ruins of old and massive stone-built structures. They will average in size from 100 by 200 feet square down to 30 by 50 feet, always in a solid block, and, with one exception, so nearly similar that a description of one will fairly represent all. This exceptional instance is explained in the sketch (Fig. 1, Plate 20), and the ground-plan, (Fig. 1, Plate 16). The peculiarity here consists principally in the size and shape of the stones employed, as well as in the design of its ground-plan. The ruin occupies one of the small isolated mesas, whose floor is composed of a distinctly laminated sandstone, breaking into regular slabs from 18 to 24 inches in thickness; these have been broken again into long blocks, and then placed in the wall upright, the largest standing five feet above the soil in which they are planted. The sketch in Plate (20) is a view along the line *a a a*, looking toward the round tower. Very nearly the entire length of this wall is made up of the large upright blocks of even thickness, fitting close together, with only occasional spaces filled up with smaller rocks. In one place the long blocks have been pushed outward by the weight of the *débris* back of it. One side of the large square apartment in the rear is made of the same kind of rocks, standing in a solid row. The walls throughout the rest of the building are composed of ordinary-sized rocks, with an occasional large upright one. Judging from the *débris*, the walls could not have been more than 8 or 10 feet in height. The foundation-line was well preserved, enabling us to measure accurately its dimensions. The large square room was depressed in the center, and its three outside walls contained less material than in the rest of the building. No sign of any aperture, either of window or door, could be detected.

Plate 20.



The far more numerous class of ruins occupying like mesas and the promontory points consist of a solid mass of small rectangular rooms, arranged without any appearance of order, conforming to the irregularities of the surface upon which they are built, and covering, usually, all of the available space chosen for their site. All are extremely old, tumbled into indefinite ridges 5 or 6 feet high, and as broad, with the stones partially crumbled into sand, and all covered with sage-brush, greasewood and junipers. They occupied every commanding and available spur of the mesas, usually so placed in the bends as to afford a clear lookout for considerable distances up and down the cañon. They resemble in this respect the sites chosen by the Moquis in building their villages; but we are not able to trace the resemblance further, from the extremely aged and ruinous state in which these remains are found. Between these fortresses and on the level bottom-lands, generally close up to the bluff upon either side, are occasional smaller ruins, resembling those at the dry camp. In connection with these a peculiar feature is shown in Plate 20, Fig. 2. At the foot of one of the promontory towns a low bench, tongue-shaped, and only about 10 feet above the valley, runs out from the mesa 200 feet in length and half as broad, through the center of which runs a wall its entire length; a portion of it is composed of the large upright rocks shown in the sketch, the largest standing seven feet above the surface and evidently extending some distance below, in order to be retained so firmly in their places. There are only seven of these standing, placed about 5 feet apart, the rest of the wall-line being composed of a low ridge of loose rock extending up to a mass of old ruins at the foot of the bluff. One side of the space divided by this wall is filled with a great pile of rocks arranged in irregular lines inclosing areas from 20 to 50 feet in diameter, the whole indicating a very considerable structure.

Grouped among the lower end of these towns were a number of the small cliff-houses; a regular colony of them occurring at the first bend of the West Montezuma, about a dozen miles above its junction with the east fork. An exceedingly well-preserved and peculiar one is shown in Fig. 1 of Plate 18. A block of sandstone setting on the edge of a mesa bench 50 feet above the valley has a deep oval hole worn in it, probably by natural agencies, which is nearly entirely occupied by a very neatly-built little house 10 feet long, 6 high, and 5 deep. A space at one end is reserved just large enough to serve as a platform to enter from.

Below the bend in which these cliff-houses occur, the Montezuma loses its cañon character and spreads out into a wide, barren valley, thickly covered with tall sage-brush, and the wash lined with large cottonwoods. The mésas upon either hand dwindle down considerably in height and abruptness, and seldom contain ruins. The large square buildings on the bottom-lands, however, are important features, and were it not for their great number, and the exceeding indefiniteness of their outlines, we might linger longer and describe each in detail. Over all are found immense quantities of broken pottery, many examples of which are shown in the accompanying plates. Arrow-points and like chipped work were especially numerous, and a great many of small size and great delicacy of finish were found.

It should have been mentioned that running water occurs in the Montezuma at the bend spoken of, and a band of Weminuche Utes, who now occupy these cañons, have considerable corn planted there. It is not impossible that formerly water was constant throughout the whole length of the region occupied by these ruins. Below the junction of the east and west forks of the Montezuma, the valley must have been

always hopelessly barren and dry, for not a vestige of any ruin occurs. At its mouth and along the San Juan, as we have noticed, they appear at once again in considerable numbers.

Our investigations closed with a side trip up into some of the sterile gorges between the two forks of the Montezuma, but without any results worth especial mention. A few small cliff-houses occurred, and a few scattered remains about the open lowlands. Upon the tops of the mesas in this vicinity, as well as upon those between the Montezuma and the Hovenweep, were old remains of towns. A glance at the accompanying map will give some idea of their distribution, although those about the head of the West Montezuma are only located approximately, in the absence of any precise notes of its topography.

POTTERY.

On the opposite page, Plate 21, we have grouped a few of the most striking examples of the pottery collected upon the trip, and which forms by far the most interesting of all the relics of the ancient people of the San Juan Valley. All who have ever visited this region, which extends from the Rio Grande to the Colorado, and southward to the Gila, have been impressed with the vast quantities of shattered pottery scattered over the whole land, sometimes where not even a ruin now remains, its more enduring nature enabling it to long outlive all other specimens of their handiwork. It is especially interesting as enabling us to see at a glance the proficiency they had attained in its manufacture and ornamentation, displaying an appreciation of proportion, and a fertility of invention in decoration, that makes us almost doubt their ante-Columbian origin; but nevertheless, without going into the details, we believe them to antedate the Spanish occupancy of this country, and to owe none of their excellence to European influences, being very likely an indigenous product.

Fig. 1 is a jar from the valley of Epsom Creek, of dark gray and rather coarse material, without color or glaze, of the indented and banded ware peculiar to the ancient artificers only. It is made by drawing the clay into ropes, and then, commencing at the bottom, building up by a continuous spiral course, each layer overlapping the one under it, the indentation being produced by a pressure with the end of the thumb, and by a slight doubling up of the cord of clay. The design is varied by running several courses around quite plain. Its diameter was 18 inches, with the same height, and 9 inches across the mouth. For so large a vessel it was very thin, not more than one-fourth of an inch. Inside, the surface was rubbed perfectly smooth.

Figs. 2, 3, 11, are restorations from well-preserved fragments of mugs or cups, each elaborately ornamented in black on a white glazed ground; the last one, especially, is of firm, excellent ware, and the design put on with great precision. The first two are 3½ inches in diameter and 4 inches high, and the last one 4½ inches in diameter by 5 inches in height.

Fig. 4 is a flat disk of pottery for covering a jar.

Fig. 5 is the small jug found at the great cave ruin on the De Chelly, (Plate 19,) 3½ inches in diameter, of dark gray ware, perfectly round, and very neatly painted. The handle has been broken off, but leaving the marks where it had been attached.

Fig. 6. A slightly oval-shaped jar, 10 inches in diameter, and a mouth 5 inches wide, with the lip rolling over sufficiently to attach a cord to carry it by.

Fig. 8. A small jug with side-handles and narrow neck, 4½ inches in diameter and 1¾ inches across mouth.

Plate 21.

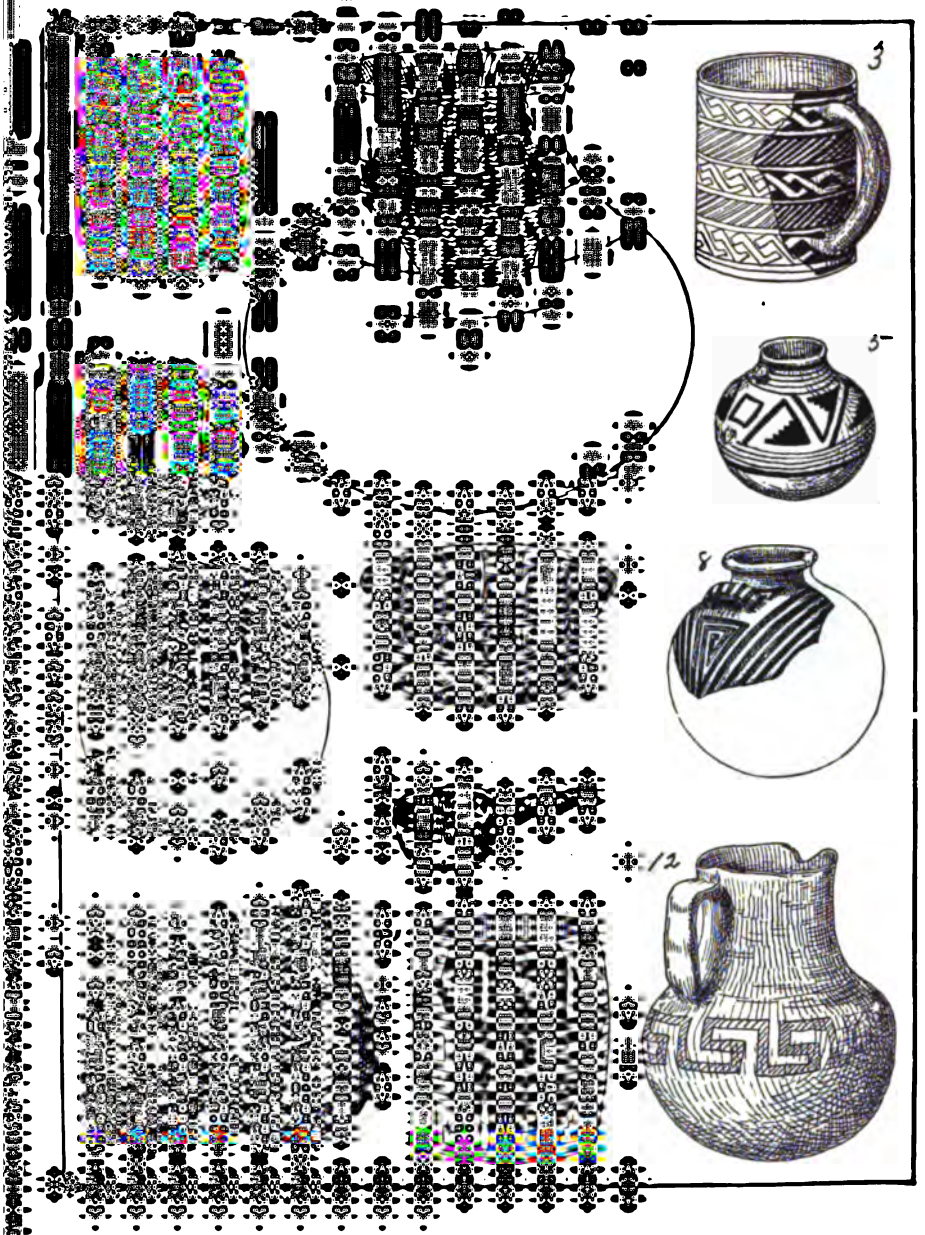


Plate 22.

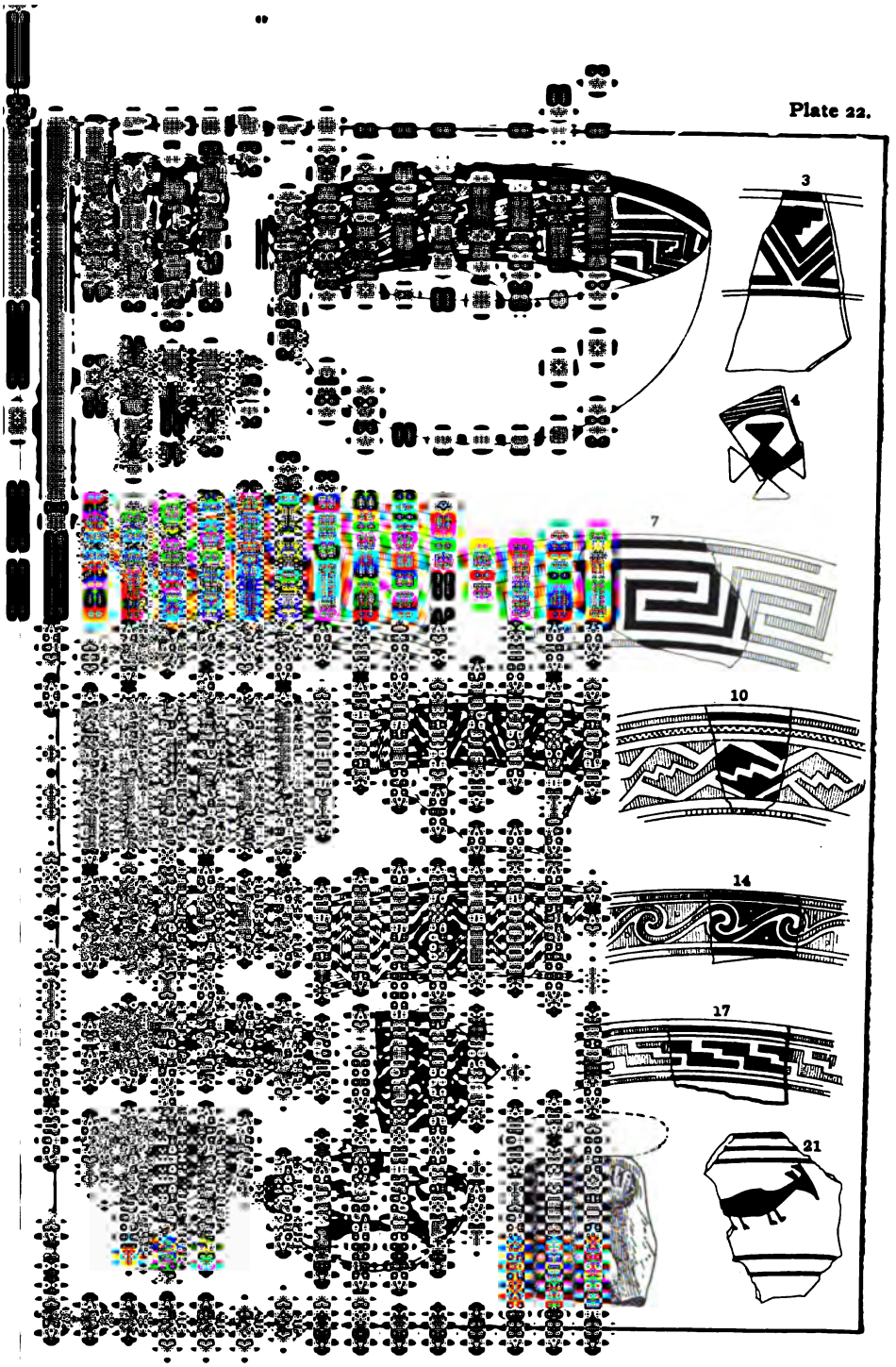


Fig. 9. A cup or dipper from Montezuma Cañon; bowl, 3½ inches diameter; handle, 4 inches long.

Fig. 12. A pitcher, taken from a grave on the banks of the San Juan, near the mouth of the Mancos, by Captain Moss. In the same find were other similar vessels, some polished stone implements, and a human jaw-bone. The ware of this pitcher is a coarse, gray material, somewhat roughly modeled, but of fine form and tasteful decoration.

Fig. 10 is a peculiar vessel, found among the Moquis of Tegua. They could give no account as to where it came from or who made it. It is probably of Zuñi manufacture. The material is rather soft, being easily cut with a knife. The upper portion is painted or glazed white, and the lower red; the figures are painted in red and black. The tallest portion is six inches in height.

Fig. 7 is an example of the modern work of the Moquis of Tegua. The material and workmanship are far below any of the preceding examples; approaching them only in its ornamentation, which is strictly inventional, but somewhat *bizarre.*

Plate 22.

This plate is intended to represent some of the most striking instances of taste and ingenuity in the ceramic decoration of the nameless potters, all the examples selected being, with one exception, from vessels of the general form of Fig. 1. With but very few exceptions the ornamentation is on the inner surface, generally in the form of a band, from 1 inch to 4 or 5 inches in breadth, but in many cases it covers the entire inner surface. If the outside of the dish is painted it is in the form of a simple narrow band, like Fig. 15. These dishes or bowls vary in size from 13 inches in diameter (Fig. 9) to mere cups of only 5 inches (Figs. 18, 19).

The ware is dark gray and nearly white; hard and firm, giving a clear ringing sound when struck. It varies in thickness from $\frac{3}{16}$ to $\frac{3}{8}$ of an inch. Many of the specimens have a fine glossy glaze upon which the black design lies without any perceptible wearing away. Figs. 7, 8, 10, and 16 are good examples, all the others but a trifle less so. This is the more noteworthy from the fact that all have been exposed in open places to all the disintegrating influences of soil and climate for probably hundreds of years. Fig. 2 appears to have suffered the most, but the white ground has worn out, leaving the black design in relief. In some, as in Fig. 2, the design is jet black, running through intermediate shades of a reddish black when the color has run thin, down to where the design is quite faint; whether from the washing away of the paint or whether it was originally so, would be hard to tell.

Fig. 4 is a design that occurs frequently in the bottom of the dishes; we found half a dozen of the same general form. Circles with many radiating points, like a delineation of the sun, also occur quite often.

In Fig. 21 we have the only example yet found from among the ancient pottery of any attempt at imitational ornament. As to what the figure is intended to represent would be rather difficult to decide satisfactorily . This fragment came from the upper cañon of the Montezuma, and represents the inner surface of the bowl ; it is reduced to about one-third in the plate.

Fig. 20 is evidently a portion of the neck of a jug or like vessel of the rough gray ware, of which Figs. 1 and 12 of Plate 21 are composed. It is another rude attempt in plastic material at the imitation of animal life, and evidently is intended for a frog. This comes also from the Montezuma Cañon.

THE HUMAN REMAINS FOUND AMONG THE ANCIENT RUINS OF SOUTH-WESTERN COLORADO AND NORTHERN NEW MEXICO.

By Dr. Emil Bessels.

The human remains collected by some of the gentlemen of the United States Geological Survey, among the ruins described by Messrs. T. H. Holmes and W. H. Jackson, are of more than common interest, as they are the first ever examined, and furnish material for conclusions in regard to the general features of the former inhabitants of the region in question.

Before giving the description of these remains, it may be advisable to insert a few short notes communicated by Mr. Holmes, bearing upon the conditions under which the bones to be described were found. They are as follows:

"The broken and much decayed skull (No. 3) was found on the Hoven Weep, about ten miles above its junction with the Mac Elmo, by Mr. Chittenden. This locality is in Colorado, about thirty miles north of the New Mexican boundary, and six miles east of the Utah line. The bones of the skeleton were projecting from the side of a deep wash and by their position seemed to indicate that the body had been buried in a squatting posture.* The skull was about four feet from the surface.

"It should be noted that these stream-courses are very stationary; that this encroachment upon the compact, vitreous soil of the flats is in all probability exceedingly slow, so that a skeleton might rest for hundreds of years quite undisturbed. There is no running water whatever during the greater part of the year. Ruins in a very advanced stage of decay were found in the neighborhood. The whole region has a desert-like aspect, and the modern tribes are not known to frequent it.

"The two more perfect skulls (Nos. 1 and 2) were obtained at an ancient ruin near Abiquiu, N. Mex. The skeletons were found entire, having been partially unearthed by a recent wash. They were within 20 or 30 feet from the eastern wall of the ruin, and judging from the description, within a very few feet from the spot where Dr. Yarrow obtained his specimens.† Fragments of pottery were found with the skeletons. The earth above them was very compact. They were three feet from the surface.

"A great number of burial-places were noticed, but of the graves examined, few yielded further evidences of occupation than small quantities of charcoal and bits of painted pottery. These burial-places are usually found on the summits of high ridges and promontories, and are still marked by slabs of sandstone set on edge, and arranged in circles and parallelograms of greatly varying dimensions; but that they did not always bury their dead in high places is proven by the frequent discovery of human remains in the arroyos or deep washes in the valleys. The skeletons were obtained in the vicinity of ruined villages, from the sides of recent washes."

Before treating in detail of the skulls, we shall notice the other parts of the skeleton.

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*We do not doubt that the position in which the bones were found, indicated a squatting posture of the skeleton, but it is not probable that this posture was commonly in use in burying the dead.—Author.

† Report of Chief of Engineers for 1875, p. 1066.

LONG BONES.

There are eight long bones among the remains, viz:

1 humerus, right.
1 ulna, right.
1 radius, left.
1 femur, left.
1 tibia, left.
1 fibula, left.
} A.

evidently belonging with the skull marked No. 1.

Besides these are,

1 femur, right.
1 femur, left.
} B.

which should undoubtedly be correlative with skull No. 2.

Description and measurements of bones A.

a. Humerus.—If we may judge from what is known in general about the proportions of the human body, the long bones combined under the head A belonged to a person about 5.6 feet high. The greatest length of the humerus, measured from the apex of the head to the inner and lower border of the trochlea 32^{cm}.2; greatest diameter of head near the anatomical neck 4^{cm}.8. Muscular insertions very marked. Antero-posterior diameter of shaft 7^{cm}.5 below insertion of supra spinatus 2^{cm}.2. Transverse diameter 2^{cm}.4; circumference7^{cm}.3. The same measurements in the middle of the bone 1^{cm}.7, 2^{cm}.3, and 6^{cm}.6, respectively, and 1^{cm}.5 above the olecranon depression 1^{cm}.8, 3^{cm}.6, and 9^{cm}.8. Extreme distance between outermost point of external and innermost of internal condyle 6^{cm}.1.

b. Ulna.—Distance from olecranon to articular part of the head of the lower extremity (styloid process broken)=26^{cm}.3; muscular insertions everywhere strongly pronounced. Greatest circumference of shaft measured 3^{cm}.7 below the highest point of coronoid process, 5^{cm}.3; antero-posterior and lateral diameters, in the same plane 1^{cm}.8 and 1^{cm}.6, respectively.

c. Radius.—Distance from highest point of head to lowermost of styloid process 24^{cm}.6; diameter of head 2^{cm}.2; depression of its upper surface rather deep; ridge for attachment of portion of supinator brevis uncommonly pronounced. The shaft does not offer anything extraordinary. Antero-posterior and transverse diameters of lower extremity 2^{cm}.3^{cm} and 3.4, respectively.

d. Femur.—The length of the femur, measured from the upper surface of the head to the inner condyle, is 45^{cm}.5, while the greatest distance between the great trochanter and the outer condyle is 43^{cm}.4. Greatest width measured between the depression for the ligamentum teres and the insertion of the gluteus medius 9^{cm}.9; greatest diameter of head 4^{cm}.6; depression for the attachment of the ligamentum teres is less ovoid than usual, and more of a reniform shape, its two diameters being 2^{cm}.0 and 1^{cm}.5, respectively. Neck very strong; greatest horizontal diameter 2^{cm}.6; greatest vertical diameter 3^{cm}.2; anterior surface without any vascular foramina and concave, while the posterior surface is more convex than usual. Antero-posterior diameter of shaft 1^{cm}.5 below the base of the lesser trochanter 2^{cm}.5; transverse diameter measured in the same plane 3^{cm}.4. The same measurements taken in the middle of shaft 2^{cm}.4 and 2^{cm}.3, and 3^{cm}.4, above the upper and external border of the trochlear surface 3^{cm}.0 and 4^{cm}.2, respectively. The three cir-

cumferences measured successively in the same planes $9^{cm}.5$, $7^{cm}.9$, and $11^{cm}.9$. In proportion to the massiveness of the bone the linea aspera not very prominent; arch for the femoral vessels not indicated. Distance from outer to inner tuberosity of lower extremity $8^{cm}.2$.

e. Tibia and fibula.—The length of the tibia, belonging with the femur above mentioned, is $38^{cm}.1$, as measured from the highest point of the spine of the head to the most distant point of the internal malleolus. Greatest antero-posterior and transverse diameters of head $5^{cm}.0$ and $7^{cm}.9$, respectively. Shaft rather platycnemic; antero-posterior diameter 6^{cm} below the attachment of the ligamentum patellæ $3^{cm}.7$; transverse diameter at the same place, $2^{cm}.5$; circumference, $9^{cm}.8$. The same measurements taken in the middle of shaft $3^{cm}.3$, $2^{cm}.1$, and $8^{cm}.5$; and repeated, 7^{cm} above the lowermost point of the internal malleolus=$2^{cm}.7$, $2^{cm}.8$, and $8^{cm}.8$. The length of the fibula, from the styloid process to the external malleolus $37^{cm}.9$; the latter projecting $2^{cm}.7$ below the inferior surface of the tibia at place of articulation. Antero-posterior diameter of shaft measured in the middle $1^{cm}.7$; transverse diameter $1^{cm}.0$, and circumference $4^{cm}.8$. If the femur and tibia be placed in natural connection the former appears to be much curved, as if it had been attached to a broad, woman-like pelvis; the skull belonging with the bones in question rather exhibits male characteristics than female.

For the sake of comparison, we shall add the following table, containing some measurements of long bones from Kentucky mounds, taken by the late Jeffries Wyman.*

Indians from Kentucky mounds.

	H.	U.	R.	F.	T.	Humerus = 1.000
	28	21	18	34	28	Ulna = 0.816
Maximum	337	284	270	479	397	Radius = 0.758
Minimum	283	214	215	383	317	Femur = 1.000
Mean	310	253	235	438	363	Tibia = 0.829

Description and measurements of bones B

The bones designated by B are two femora belonging together, consequently it will be sufficient to consider only one of them, and we shall choose the right one for this purpose. Length from upper surface of head to lowermost point of inner condyle $35^{cm}.6$. Distance between uppermost point of great trochanter and lowermost of outer condyle $33^{cm}.1$. Distance from outermost point of the head to outermost point of trochanter major $7^{cm}.2$. Greatest horizontal diameter of neck $1^{cm}.8$; greatest vertical diameter $2^{cm}.5$; diagonal line of the outer surface of the great trochanter not prominent; triangular surface for the attachment of the tendon of the gluteus medius smooth. Antero-posterior diameter of shaft $2^{cm}.3$; below the summit of lesser trochanter $1^{cm}.8$; transverse diameter $2^{cm}.4$. Same measurement in the middle of bone $2^{cm}.0$ by $2^{cm}.2$, and $2^{cm}.9$ above the upper and external border of the trochlear surface $2^{cm}.1$ by $3^{cm}.0$. The three circumferences measured successively in the same planes, $6^{cm}.7$, $6^{cm}.2$, and $9^{cm}.1$. Arch for the reception of the femoral vessels very deep.

* Fourth Annual Report of the Trustees of the Peabody Museum of American Archæology and Ethnology. Boston, 1871, p. 19.

DESCRIPTION OF SKULLS.

The three skulls forming the more interesting part of the remains are designated by Nos. 1, 2, and 3, respectively.

Skull No. 1.—*Plates* 23, 24, *and* 25, (*Fig.* 5.)

This is almost perfect, with the exception of the right styloid process, which is missing, and the two condyles articulating with the atlas, which, according to all appearance, were broken off quite recently.

Viewed from above, the outline of the massive skull is somewhat heart-shaped, and but little irregular, the irregularity being chiefly due to the depression of the posterior portion of the left parietal bone. This depression extends also, but less marked, a short distance over the right parietal, inclosing a somewhat triangular space, and likewise over the occipital, down to the protuberance. Serration of sagittal suture coarse. A small Wormian bone in the coronal near the left temporal ridge. Parietal tubers very pronounced.

In profile the considerable height of the skull is very striking, as is also the depression, if the left side be turned toward the observer. Occiput, from a plane laid horizontally through the tubera parietalia downward, straight, almost perpendicular, the central portion of the occipital only bulging out slightly. Temporal ridges pronounced; mastoid process heavy; meatus rather elongated. Upper portion of frontal, from the region of the tubera, receding; supra-orbital arches moderately convex. Naso-frontal angle considerable, indicating aquiline features; anterior nasal spine prominent. There is a slight tendency to prognathism.

A frontal view shows a moderately broad forehead; distance between the orbits rather considerable; left supra-orbital foramen exceedingly small; the right supra-orbital arch shows 3 foramina. Malars massive; incisive fossæ deep; canine eminences considerable. Muscular insertions of the lower jaw invariably very pronounced, but the exterior oblique line comparatively weakly developed. Height of ramus 7.^{cm}.1. Teeth normal, their crowns slightly worn down, especially those of the incisors, but in excellent state of preservation.

In a base view the deformation shows almost as much as in profile. The left mastoid process, being more obtuse than the right one, is pushed forward, and, in connection with this the foramen magnum is somewhat asymmetrical and distorted. Left posterior condyloid foramen wanting; the spot where it ought to be is, however, very thin; and, as in similar cases, the size of the existing foramen is greater than usual. The effect of distortion may be noticed along the entire left portion of the base, on which side the eruption of the last molar never took place, although the right one cut through.

Viewed from behind, the outline of the skull is hexagonal. Parietals sloping considerably from the sagittal suture to the tubera, from which they form an almost perpendicular line to the mastoid portions of the squamosals. Lower outline of occipital but slightly convex. The internal occipital protuberance is but faintly indicated, especially if compared with other muscular insertions, but the ridge is strongly marked. While the right depression for the insertion of the rectus capitis posticus is deep and well developed, the opposite is but shallow.

Before giving the conventional measurements it may be well to state that the indices of height and breadth were intentionally omitted, as, on account of the deformation of the skull, they would be of little value.

Measurements.

	c. cm.
Capacity	1325
	mm.
Length	168
Breadth	144
Breadth of frontal	119
Height	135
Frontal arch	319
Parietal arch	346
Occipital arch	234
Longitudinal arch	359
Circumference	508
Length of frontal	123
Length of parietal	134
Length of occipital	160
Zygomatic diameter	144

Skull No. 2.—Plates 25, (*Fig.* 2,) 26, *and* 27.

According to its features, the skull designated by No. 2 is that of a woman, and is, with the exception of the zygomatic bones, which are broken, well preserved. If, among the Indians, the eruption of the last molars takes place at the same time as in our race, the skull in question cannot have belonged to a person much younger or older than seventeen.* In general, the skull is delicately built, being rather small, showing smooth surfaces and weak muscular insertions.

Viewed from above, it presents outlines similar to the skull previously described, but while the latter is deformed on its left side, the one in question is compressed on its right and is asymmetrical in a far higher degree.

In a profile view we notice above all, highly developed prognathism, a rather low forehead, and the outline of the occiput to be nearly straight. This latter fact is brought to view more strikingly if we look upon the right side of the skull, where we can lay almost a straight line from near the tuber over the surface of the parietal to the mastoid process, touching within a few millimeters the lambdoidal suture. If we measure the distance from the glabella to the left superior curved line of the occiput, it will be 1^{cm}.3 greater than if measured between the same points on the opposite side, thus showing clearly the asymmetry of the skull.

A view from behind exhibits this less than one from the base, the latter revealing a distortion extending from the right side of the occipital to the narrow and elongated palate process of the maxilla, which is pressed forward. As in almost every instance of prognathism, the foramen magnum is thrown backward. This is, however, not only due to the protruding position of the upper maxilla, but also to a great extent to the flattening of the occiput, causing the occipital bone to turn upward almost abruptly within about half a centimeter from the posterior margin of the foramen magnum, that is on the right side of the skull, there being a little more space on the left. Both posterior condyloid foramina are well developed, the right one being larger than the left. The muscular insertions on the left side of the occipital are more strongly marked than those of the right, especially the places of insertion of the complexus and the rectus capitis. The protuberance is

*As puberty takes place sooner among Indians than among white men in general, we may conclude that the eruption of the last molars occurs earlier with the former races than with the latter.

scarcely indicated. The lambdoidal suture shows two Wormian bones where it joins the sagittal, one being situated to the right, the other to the left of the latter, measuring $2^{cm}.2$ and $3^{cm}.2$, respectively. Another but smaller Wormian bone may be noticed, where the left lambdoidal joins the squamous suture. The mastoid processes are rather obtuse and small, the digastric fossa of the left being longer and deeper than that of the right, while the right mastoid foramen is larger and situated somewhat higher than the one opposite. The parietal eminences are not very distinct, although they may be recognized by viewing the skull from above; the temporal ridges are not indicated at all, and the right parietal foramen is situated before the left one and is about twice as large. Coronal suture rather straight, without many serrations. The frontal bone is without any median ridge or trace of suture, the eminences are but slightly developed, the superciliary ridges scarcely indicated, and the temporal ridges only well marked in the vicinity of the supra-orbital arches. The angle formed by the nasal bones with the frontal, and the curvature of the nasal bones are rather flat, nasal meatus rather round, anterior nasal spine moderately protruding. The number of teeth in the upper jaw complete, the last molars on each side in the act of eruption. Teeth rather small, with the exception of the incisors, which are directed much more obliquely forward than downward; canines smaller than the incisors; only the crowns of second and third molars ground flat; the other teeth of the upper jaw scarcely showing any wear, while the incisors of the lower bear the marks of extensive use; not so, however, the molars, which are almost intact, at least those on the left side. Symphysis of the lower jaw scarcely visible, mental process tolerably developed, and incisive fossa of the right deeper than that of the left. External oblique line only well indicated near the anterior border of the ramus. Coronal process rather pointed; insertion of the internal pterygoid muscle less than usually rough.

Measurements.

	c. cm.
Capacity	1020
	mm.
Length	150
Breadth	131
Breadth of frontal	106
Height	130
Frontal arch	278
Parietal arch	325
Occipital arch	226
Longitudinal arch	342
Circumference	450
Length of frontal	118
Length of parietal	117
Length of occipital	150
Zygomatic diameter*	116

Skull No. 3.—*Plates* 28 *and* 29, (*Fig.* 13.)

The skull designated by this number is rather thin, and was broken into a number of small fragments when brought from the field, and the pieces themselves were very fragile. It could, however, be sufficiently well restored to convey a good idea of its general features, which are decidedly masculine and even animal-like.

* The zygomatic bones being broken, the zygomatic diameter could only be ascertained approximately. Probable error = $\pm 1^{mm}.5$.

Although the occipital bone is almost entirely wanting, it may still readily be seen that the skull had been deformed in a manner analogous to the two others, and as it seems, chiefly on its right side, as a view from above will demonstrate, although the depression of the occipital region does not seem to have been as great as in either of the cases above mentioned. The outline of the cranium is more oval than that of No. 1 and No. 2, and appears somewhat flattened near the median line along the parietals. The superciliary ridges protrude very considerably beyond the general outline of the frontal, and in the same view, from above the zygomatic bones, the nasals and the upper maxillæ may be seen to project. There are no traces left of the sagittal suture; the direction of the latter cannot even be detected if the skull be held against a strong light; but the coronal is plainly visible. As already stated, the occipital bone is almost entirely broken, there being left only a narrow piece of its upper portion, which measures about 9 centimeters in length. The right side of the skull is of a dark brown color, which is frequently noticed on bones exhumed from peat-bogs. An examination proved the coloring matter to be chiefly iron. Like the rest of the surface the right side, besides being colored, is covered by numerous fine cracks and grooves, either produced by running water that dissolved the carbonate of lime of the osseous tissue, or by the roots of plants that assimilated the salts. The side under consideration has the exterior portion of the mastoid process, which is rather massive, preserved. Temporal ridge extremely developed; zygomatic process strong. Frontal bone receding almost as much as in some ancient Peruvian skulls that lie before me, and which are artificially deformed. Superciliary ridges very prominent; nasals strongly curved, aquiline; upper maxilla prognathic in a considerable degree.

In a front view the heavy superciliary ridges appear very marked; supra-orbital arches strong; foramina large; anterior nasal spine projecting; septum oblique, its posterior portion shifted toward the right from the median line. First left incisor partly decayed; crowns of the teeth, especially on that of the molars, ground down. Insertions of muscles of lower jaw strong; those of the left more developed than the right; mental process prominent. Height of ramus from angle to highest point of condyle, $6^{cm}.8$; sigmoid notch deep; distance between the outermost points of right and left condyles, $12^{cm}.2$.

Measurements.

	c.cm
Capacity	——
	mm.
Length	——
Breadth	136
Breadth of frontal	119
Height	——
Frontal arch	297
Parietal arch	338
Occipital arch	——
Longitudinal arch	——
Circumference	——
Length of frontal	126
Length of parietal	132
Length of occipital	——
Zygomatic diameter	144

Thanks to the kindness of Dr. A. Otis, who, with his usual liberality, placed the osteological collection of the United States Army Medical Museum at my disposal, I could examine the two skulls collected by

Doctor Yarrow in the vicinity of the ruins near Abiquiu, to which I took occasion to refer on one of the preceding pages. One of them, bearing the number 1178 in the catalogue, is that of a child about ten years old. The other, marked 1179, is that of an adult, and exhibits the general characters of a female.

We shall first consider No. 1178, which is distorted about as much as No. 2; but while the latter is deformed on its right side, the former is compressed on its left, and is asymmetrical through its entire extent, including the lower jaw. Viewed from behind, it is of almost quinquelateral shape, the two upper sides of the pentagon being formed by the parietals sloping down slightly from the coronal suture to the tubers; the two lateral sides are formed partly by the parietals and the posterior portions of the squamosals, sloping from the parietal tubers to the mastoid processes, which are very small and obtuse, while the base of the polygon is formed by a line running obliquely from the left zygomatic process across the occipital to within two centimeters of the right mastoid; protuberance of occiput scarcely developed; superior and inferior curved lines wanting; muscular insertions weak.

Owing to the deformation of the skull, the two profile views are rather different from each other. The right side of the cranial portion does not present any extraordinary features, except toward the frontal region and the adjoining facial portion. The left frontal tuber projects about one centimeter above the right one, the whole left half of the frontal being pressed forward, in consequence of which the right side seems to recede to a considerable extent; ridge of the nasals slightly curved inward. There is slight tendency to prognathism. The left profile shows the occipital depressions in almost its whole extent, the lower and posterior portion of the parietal being flat, almost concave instead of convex; this is also the case with the left portion of the occipital. The asymmetry of the skull becomes not less striking in a facial view, in which case the frontal bone recedes in an oblique direction from the left tuber to a short distance behind the right one. The lower jaw partakes, in a similar manner, in the distortion, its left half being also pressed forward, but less than the corresponding half of the frontal bone. The lower border curved inward and upward rather deeply near the symphyses, the curve descending lower on the right side than on the left.

Viewed from above, the skull is of an irregular oval form, the left frontal tuber projecting beyond the general outline, and the posterior portion of the parietal of the same side being compressed, so that the right parietal tuber appears to be very prominent.

Unfortunately the base is not complete; but, although the lower and anterior portion of the occipital and the basilar process are missing, there is evidence enough of the general distortion. The left mastoid process is about one centimeter beyond the right one, and, although to a less extent, we notice both the palate bone and the palate process of the left upper maxilla to be pressed forward.

Measurements.

	c. m.
Capacity	1213
	mm.
Length	151
Breadth	138
Breadth of frontal	110
Height*	—
Frontal arch	271

* The anterior margin of the foramen magnum being defective, the height could not be ascertained.

	mm.
Parietal arch	349
Occipital arch	195
Longitudinal arch	341
Circumference	357
Length of frontal	115
Length of parietal	126
Length of occipital	153
Zygomatic diameter	100

Skull No. 1179 rather delicate; is deformed in a more regular manner than either of the others above mentioned, and might very well be taken for that of an ancient Peruvian. The frontal does not recede as much as it usually does in Peruvian skulls, owing to their mode of deformation, but in this instance the lower anterior portion of the frontal ascends very straight, almost perpendicular, and more so than in any of the other skulls.

Viewed from above, it is broadly heart-shaped, having its greatest breadth about one centimeter above the insertion of the retrahens aurem in a plane projected perpendicular through the posterior portions of the zygomatic processes. The nasal bones and the alveolar processes of the upper jaw protrude to a considerable extent beyond the general outline of the cranium, while the malars and zygomatic processes stand out but slightly, the former, however, more than the latter. In profile the occipital portion of the skull appears perpendicular within a few degrees; only the left portion of the occipital bone protrudes a little near the superior curved line, which on this side is more developed than on the other. Left zygomatic process slender; the right one defective, partly broken. Nasal bones very projecting, indicating a Roman nose.

Facial portion comparatively small; forehead narrow; frontal tubers well developed; superciliary ridges but slightly indicated. Malars slender; anterior nasal spine prominent; maxillæ very nearly orthognathic. Teeth very irregular; left incisors of upper jaw missing; the first right one very large, while the second is unnaturally small. Canines standing very oblique, their crowns inclined to a considerable extent toward the symphysis. Second right bicuspid temporary; permanent one in the act of eruption, last molars not yet cut, their position somewhat abnormal. The teeth of the lower jaw are more regular. Both false molars of the left side and second on the right missing, last molar not yet erupted. Mental process well developed; exterior oblique line slightly indicated; sigmoid notch flat; ridges for the insertion of the masseter slight; anterior border of ramus almost straight.

The base of the skull is nearly triangular, and only slightly asymmetrical. Posterior outline of occipital almost straight, and approaching within half a centimeter toward the posterior margin of the foramen magnum. Muscular insertions highly developed; occipital protuberance very much elongated. Condyles long and narrow; their surfaces quite uneven. Only the right posterior condyloid foramen developed and very small; fossa on this side shallow; the one opposite deep.

Measurements.

	c. cm.
Capacity	1380
	mm.
Length	153
Breadth	156
Breadth of frontal	128
Height	142
Frontal arch	316
Parietal arch	370
Occipital arch	240

	mm.
Longitudinal arch	338
Circumference	495
Length of frontal	115
Length of parietal	130
Length of occipital	163
Zygomatic diameter	123

In order to show the resemblance between the skulls from Southern Colorado and New Mexico, described on the preceding pages, and those of the ancient Peruvians, the diagram, Fig. 14 on Pl. 29, was drawn. Before referring to the latter, we may be allowed to recall the fact that there are two different types of Peruvian skulls, one kind being lengthened similarly to those of the Macrocephali of Hippocrates,* and found chiefly in the chulpas near Lake Titicaca, while those from other localities, and not met with under the "burial towers," are shortened by compression of the occipital region. We hardly need to state that the type alluded to here is the latter one.† The skull, whose profile is represented by the less heavy lines, belongs to the collection of the United States Army Medical Museum. It bears the number 250 of the catalogue, and is designated as "Pachacamac skull, from Peru." Viewed from above it is similar in outline to skull 1179, previously described, (represented in heavy lines on the diagram.) Its frontal bone only proves to be more receding and elongated than that of the latter, it being, besides, a little longer, and in the norma verticalis we perceive the zygomatic bones, the nasals, and the upper maxillæ, to project more beyond the general outlines of the cranium than it is the case with No. 1179. It is rather thick and heavy, apparently male, with pronounced muscular insertions. Those of its measurements that may be of interest in our case are as follows:

	mm.
Length	162
Breadth	156
Breadth of frontal	118
Length of frontal	119
Circumference	505

The dotted profile line of the diagram is that of skull No. 276 of the catalogue above mentioned, and designated as "Cranium of pure Indian. Coban, Guatemala." Viewed from above it appears slightly asymmetrical, the left parietal being compressed at its posterior portion, between the lower third of the sagittal suture, the tuber, and the squamosal. The zygomatic bones and the malars project beyond the general outline of the cranium in this position, and likewise the superciliar ridges and the nasals, the greatest breadth being found a little below the parietal tubers. Apparently male; muscular insertions very pronounced; skull heavy and thick.

As measurements of interest I shall give:

	mm.
Length	162
Breadth	142
Breadth of frontal	112
Length of frontal	122
Circumference	481

* Magni Hippocratis medicorum omnium facile principis opera omnia quæ exstant, nunc denuo latina interpretatione et annotationibus illustrata, Antio Foesio Mediomatrico medico authore. Francofurti, MDCXXIV, page 289.

† *Mariano Eduardo de Rivero y Juan Diego de Tschudi, Antiguedades Peruanas, Vienna,* 1851, p. 25, where the type in question is represented, with two others, the authors distinguishing three types on rather trivial grounds. A large view of the type under consideration is also figured in the atlas accompanying the volume, Plate V.

In order not to crowd and confuse the diagram we omitted the outline of skull No. 3, the frontal portion of which (even to the superciliary ridges) would almost overlap that of the Peruvian. It will be seen that the general character of the profile views of the three skulls is not very different, the Abiquiu cranium showing the greatest height, the steepest forehead, and an almost straight occipital outline, while that from Coban is intermediate between the two others. The cranium having the greatest length is that of the Peruvian, viz, 162^{mm}, differing only 1^{mm} from that of the Coban Indian. In the diagram this difference seems to be greater, as the occipital outline of the Peruvian projects considerably beyond that of the former; but if we come to examine the receding frontal of the latter and remember that the greatest length lies between the glabella and the most prominent point of the occiput, then the features of the diagram appear to be quite normal. A comparison of the breadth of the crania bears out the fact that the measurements of the Peruvian and Abiquiu Indian coincide exactly, they being both 156^{mm}, while that of the Coban Indian gives 12^{mm} less. In regard to the breadth of the frontal bone the Abiquiu skull exhibits the maximum, viz, 128^{mm}; next to this is the Peruvian, namely, 118^{mm}; and finally the Coban Indian, measuring 112^{mm} only. The length of the same bone is greatest in the Coban Indian, its measurement giving 122^{mm}, that of the Peruvian being 3^{mm}, and that of the skull from Abiquiu 7^{mm} shorter. The Peruvian skull being the longest among the three, has also the most considerable circumference, namely, 505^{mm}, while the Abiquiu Indian measures 495^{mm} around, and the skull from Coban 461^{mm} only.

After this paper had been placed in the hands of the printer, the United States National Museum at the Smithsonion Institution received a box with relics exhumed from mounds in Tennessee, which happened to be opened in my presence. Besides several cubic feet of bone fragments it contained two crania, showing exactly the same mode of deformation as the skulls obtained in the vicinity of the ruins. And indeed the resemblance between the crania from those two different localities is so great that they might readily be confounded.

It being too late to present cuts of these specimens, I shall limit myself by describing the same, designating one by A and the other by B.

Cranium A.

Very light and smooth, and apparently that of a woman. As the eruption of the last molars had taken place, the individual must have been at least twenty-one years of age when it died; that is, if we are justified in using the same criterion in judging the age of an Indian as we do in judging that of a white man. Taking into consideration that the skull was taken from a mound, it is in a tolerable state of preservation; the left zygomatic bone and the styloid processes being broken, however, and the upper jaw containing but six teeth. The condition of the lower is less good, there being only three teeth left, the rami being rather defective and the condyloid and coronoid processes wanting.

Viewed from above, the skull is irregularly heart-shaped; the irregularity being produced by the compression of the left parietal. The compression extends from a plane laid horizontally through the tubers, from the right tuber down to the squamous and occipital sutures, so that the left bone and tuberosity seem to protrude considerably. Serration of the sagittal suture strong, the two parietals grooved at their line of junction. The zygomatic bones project but slightly beyond the general

outline of the cranium; the malars, the maxillæ and the nasals more so, especially the latter.

The two profiles show somewhat different features. While the outline of the occipital region, when viewed from the right, is almost perpendicular, that of the left slopes at a slight angle, and the left parietal tuber appears more prominent in this view than the right. Zygoma and malar thin; forehead straight; frontal tubers not projecting; angle between frontal and nasals sharp; anterior nasal spine prominent; upper maxillæ but slightly prognathous.

A facial view discloses a rather narrow forehead, frontal tubers, which are very slight, standing close together, no superciliary ridges, supraorbital ridges very slight, the right one showing two foramina. Orbits rather oval and nose broad. Maxillæ smooth; canine eminence very slight. Remaining teeth showing but little wear; the crowns of the two first molars being worn down most.

Viewed from behind, the outline represents an irregular hexagon. Parietals sloping roof-like from the apex to the tubers, from there almost straight to mastoid portion of the squamosal. From the mastoids the slightly curved outlines converge toward the posterior margin of the great foramen. The left portion of the lambdoidal suture contains three Wormian bones, one fourteen millimeters long and about five wide, being situated in its upper third, while the two others, of smaller dimensions, at least in regard to length, are close together, almost touching the lower extremity of the suture. Superior curved line well pronounced, the same being the case in regard to the inferior. Muscular insertions of the left side more marked than those of the right, especially the depression for the rectus capitis. Mastoid processes obtuse.

In a base view the compression of the left side of the skull shows hardly as much as from above, and the asymmetry does not extend over the whole base as it did in several of the other instances.

In taking the dimensions, the zygomatic diameter could not be ascertained very accurately; the probable error of measurement is, however, supposed to be not more than $\pm$ $1^{mm}.5$. As the skulls are not yet cleaned, the internal capacity was not measured.

Measurements.

	mm.
Length	156
Breadth	141
Breadth of frontal	109
Height	142
Frontal arch	277
Parietal arch	330
Occipital arch	227
Longitudinal arch	335
Circumference	470
Length of frontal	115
Length of parietal	128
Length of occipital	160
Zygomatic diameter	124

Cranium B.

The whole facial portion being broken off, only the cranial portion of the skull is left, and this is rather defective, as the left squamosal and the anterior part of the occipital are wanting. Cranium very light, showing smooth surfaces; age doubtful, but the individual was evidently younger than that from which skull A was derived.

Viewed from above, it appears like a rounded oval, occipital region flattened, right side more than left, asymmetry slightly less than in other specimens. Parietal tubers prominent. Serration of sutures fine.

The right profile, which is more complete than the left one, shows an almost perpendicular but slightly outward curved outline of the occipital region, while in the left view the occipital is seen to bulge out to considerable extent. Temporal ridge narrow and sharp. Mastoid process narrow and small.

A front view shows nothing but the narrow and straight forehead, with tolerably developed tubera, and very slight superciliary ridges.

Viewed from behind, the roof of the skull appears rather flat, with only a slight curvature of the parietals from the sagittal suture to the tubera, while the rest of the outline is similar to that of skull A. Serration of lambdoidal suture complicated. Muscular insertions of the lower portion of the occipital tolerably developed.

Owing to the defective condition of the skull only a limited number of measurements could be obtained. In taking those of the frontal and parietal arches and of the circumference only one-half of the actual distance was measured, and in consequence of this the numbers thus derived had to be multiplied by 2 in order to get the whole dimensions.

Measurements.

	mm.
Length	153
Breadth	140
Breadth of frontal	118
Frontal arch	280
Parietal arch	222
Occipital arch	212
Circumference	460
Length of frontal	129
Length of parietal	131

GENERAL CONSIDERATIONS.

Disregarding the two skulls obtained from the Tennessee mounds, we notice, as characteristics of the others, the great height and breadth of the cranium, which is most decidedly brachycephalic. As the skulls are deformed we refrain from calculating the indices of height and breadth.

Denoting the excess of the longitudinal diameter as compared with the transverse one as positive, and that of the transverse diameter as compared with the longitudinal one as negative, we obtain the following values:

Designation of skull.	L. B.
No. 1	+ 24mm.
No. 3	+ 19
No. 1778	+ 13
No. 1779	+ 3

It will readily be seen that the adult Abiquiu skull (1779) is more broad than long, while the others are somewhat longer than they are broad. If we were to calculate the index of breadth we would notice it to decrease in the order adopted in the table, from skull No. 1779 upward. How far the brachycephalic character is due to deformation cannot be decided by means of the limited number of specimens on hand, but according to the general features of the skulls, we consider ourselves justified in saying that originally they were brachycephalic, and that in consequence of the deformation of the occiput the brachycephalic character is brought to view more strikingly than it would be if the skulls had not been

compressed. We do not hesitate to express this opinion, although it appears from Welcker's extensive investigations* that brachycephalic skulls are mostly orthognathous, while those described above are all more or less prognathous.

Now the question arises, was the deformation to be found among the ancient inhabitants of the ruins generally, or only in some instances? Was it practiced as a rule, or is the compression only more or less accidental? As the five skulls before us show the most unmistakable signs of deformation, it is more than probable that the compression of the skull cannot have been of rare occurrence, for it is scarcely possible that, by a mere accident only, the deformed crania should have been found by the collectors, while others, showing normal features, should have escaped their observation.

If deformations of this kind are practiced, as a rule, among savages or civilized people, there is always a guiding idea,† either emanating from æsthetical feelings or with reference to some practical purpose. For instance, among the ancient Peruvians the flattened skulls were considered a sign of aristocracy and high breeding, while in other cases, as among the inhabitants of the northwestern corner of Europe,‡ the skulls of the children were deformed in early youth in such a manner as to produce a more or less straight line of profile, which we are accustomed to admire in the Greek ideal of human beauty.

That the idea of the b autiful was developed to an uncommon extent among the inhabitants of the ruins is borne out by the fact that the fragments of pottery found show simple but tasteful ornamentation, that great regularity prevails in the structure of their buildings, both in the square and round ones, and that other pieces of their handiwork would even gratify our own æsthetical feelings. As symmetry is found everywhere among their buildings, even where an educated eye would require it, there is no reason whatever to suppose that the taste should comply with these requirements in one instance and not in the other. Why should people who bestow so much care upon a door, in order to make it symmetrical, or upon a piece of pottery, to make it perfect in shape, try, in case they practice deformation of the skull, to produce an asymmetrical form, such as is found in the greater number of our crania?§ Wherever deformation of the skull is made a practice, the mother, or whoever may be in charge of the child, performs this operation with the utmost care, in order to produce the conventional shape, which is almost symmetrical in every instance; and some time ago, when we had occasion to examine about 200 flatheads, we found but few that were not symmetrical.

Under such circumstances we are justified in believing that the deformation of the skulls in question is more or less accidental, and, taking the mode of depression into consideration, there cannot remain any doubt in regard to the way the skulls were distorted. Evidently the ancient inhabitants of the ruins were in the habit of strapping their children against cradle-boards, as a great many modern Indians do, and hence resulted the flattening of the occiput.‖

*Untersuchungen ueber Wachsthum und Bau des menschlichen Schädels von Hermann Welcker. Erster Theil. Leipzig, Wilhelm Engelmann, 1862, p. 63 and 90.

†Andreæ Vesalii Opera Omnia Anatomica et Chirurgica, cura Hermanni Boerhaave et Bernhardii Siegfried Albini. Lugdini Batavorum, MDCCXXV, Tom. I, p. 16.

‡Hippocrates: loc. cit., De aëre aquis et locis, p. 289.

§As it seems, asymmetry is not met with very seldom among the ancient Peruvian skulls. Compare Morton Crania Americana, Pl. X.

‖As Major Powell kindly informs me, the different Indian tribes he is familiar with keep their children strapped to the cradle-board from between one and a half to two years.

With reference to this question, we examined a considerable number of Indian skulls contained in the collection of the United States Army Medical Museum, but we must confess that among the modern ones we did not meet with any deformation that could reasonably be attributed to the influence alluded to. Among a series of skulls exhumed from mounds in Kentucky, No. 723 is deformed very slightly, while No. 730 shows a pronounced depression of the lower and posterior portion of the left parietal bone, and in No. 242 we meet with an almost perpendicular occiput, perceptible especially when viewed from the right side. A considerable number of crania from mounds near Vicksburgh, Miss., could not be used to strengthen our argument, as they are all, with scarcely any exception, deformed intentionally and in every possible direction.

Having obtained these rather negative results, we examined the collection of Indian cradles contained in the National Museum, trying to establish some relation between the construction of the cradle-board and the mode of deformation of the skull. If we were to judge from the specimens as they present themselves at the Smithsonian Institution, we might under the circumstances arrive at erroneous conclusions, as most likely the majority of these cradles are incomplete, consisting in most cases of scarcely anything but the frame-work. Probably, some tribes prepare the head-rests for the children more carefully than others, and the deformation of the skull will be found accordingly.

Unfortunately, there are no skulls of Indian tribes that now inhabit the vicinity of the region in question within our reach, and therefore we are unable to draw any comparisons or to point out cranial affinities that might exist between the ancient inhabitants of the ruins and the people that now live near those deserted dwellings.

According to other evidence, however, there is not much room left to doubt that the present Pueblo Indians are the direct descendants of the ancient inhabitants of Southern Colorado and New Mexico, although there are either no traditions preserved pointing toward this direction, or the few that do exist are of too vague a nature to be relied upon. As one of the arguments in favor of this view, we may take the mode of constructing the houses. The structures erected by the present Pueblos do not differ materially from the majority of dwellings built by the ancient architects. The whole modifications the former offer are merely due to the different topographical features of the ground on which they stand, and to the influence of the white race, as can readily be proven. In the present mode of constructing the dwellings, there is, however, one detail worthy of attention and further investigation. We mean the arched building,* as there are but two tribes inhabiting this continent whose architectural skill proved efficient enough for this purpose, namely, the Peruvians and the Eskimos. As the dome-like structure is only found among this race (besides the people just mentioned), it would be worth while to investigate whether this style of architecture is original or adopted from the Spaniards, and whether it is of rare occurrence or to be met with frequently.

As another evidence in favor of the view that the present Pueblos are the descendants, or rather the remnant, of the ancient cliff-house builders, we may take the pottery found near the ruins. The shape of the pots now in use among the Pueblos is the same as that of the few pieces brought east, so are the ladles with their characteristic hollow handles, and the ancients were in the habit of burying their water-jugs in the ground in order to keep them cool, just as we see it practiced

* "Descending to the chamber by a ladder, it was found probably twenty-five or thirty feet in diameter, *arched above*, and about twenty feet high."—Report of Chief of Engineers, p. 1067.

now. If we were to take the pattern of the primitive ornaments as a criterion—which is, however, not permissible, as certain figures are found in all parts of our planet, wherever people are far enough advanced to invent and to use ornaments—we would meet with the same designs in both instances, only that in the majority of cases the ancient ornamentation is more careful, and exhibits besides more artistic feeling on the part of the workman than that of the modern.

The most striking peculiarity of a large number of fragments of pottery found near the ruins, and hitherto never noticed in America, is the existence of a regular glazing of great hardness. How this glazing was produced cannot be ascertained without considerable difficulty. In some instances, it is rather opaque, whitish, and covers the surface of the fragment in a thick layer, while in others it is perfectly transparent or shows a slight bluish hue. The colors used in painting the pottery are the same as now, namely, a reddish-brown, brown, and black; the former being produced by iron and manganese, the latter consisting of an organic substance, the character of which could not be determined. Until we shall have some accurate analysis, which will be rather difficult to make, we may perhaps call this organic substance charcoal, mixed intimately with fine clay before it was used for painting, and prevented by the silicious cover from being destroyed by the heat while the vessel was being baked. A closer examination of the different patterns demonstrates that the painting was done in a very careful, in some instances hesitating, manner, and it seems that a great deal of time was devoted to this process. There are several fragments on which we may easily recognize the method followed by the artist, and notice how he drew his outlines and how he afterward painted the rest of the square or triangle.

The facts bearing upon the probable age of the human remains are rather contradictory, and it is difficult to make them agree and to draw some satisfactory conclusions. Evidently, the buildings near which they were found represent different ages of perhaps considerable periods of time. How far back the earliest ones may date can scarcely be surmised, but there are some instances, resting however on rather unsatisfactory bases, that might give us some clew as to the approximate time the buildings were abandoned.

Mr. Jackson states that he noticed several places that appeared to have been used as corrals, and from Dr. Endlich I learn that he discovered a stratum ten feet below the surface of the soil, containing, besides fragments of pottery, numerous bones of sheep. Now, nothing would be more tempting than to combine these two facts, and to conclude that the people in question domesticated sheep, which could not have been done during the pre-Columbian period, as this animal does not belong to the American fauna.

Among a collection of arrow-heads and minor stone chips, I noticed a glass bead, which is, beyond doubt, of Venetian workmanship, and very similar to beads exhumed lately from the grave-mounds at Santa Barbara, Lower California, and preserved at the National Museum. If the bead in question did not find its way accidentally to the ruins through some Indian of a later period, we might consider it as a proof in favor of our view; but at the same time we must not forget that no trace of any metal was found in the graves, as we might have reasonably expected, since the cliff-house builders communicated directly or indirectly with the inhabitants of the Pacific coast. This latter fact is supported by the presence of a considerable quantity of shells of *Olivella gracilis*

used as beads, and by a large spine-fragment of a recent *Echinus*, which I noticed among some pieces collected by Mr. Jackson.

It would exceed the limits of these pages, to the preparation of which we could devote but a few days, to make any further remarks which would so readily suggest themselves. Evidently, the ruins in question bear testimony of one of the earliest centers of civilization in this country, and would well repay the investigations of a critical anthropologist. Let us hope that ere long such investigation may be undertaken.

N. B.—All the drawings contained in the following plates are orthographic figures, made by means of a diopter, and reduced with a pantograph from natural size.

PLATE 23.

Fig. 1.—Lateral view of skull No. 1.
Fig. 2.—Frontal view of the same.

PLATE 24.

Fig. 3.—Occipital view of skull No. 1.
Fig. 4.—Lateral view of the same.

PLATE 25.

Fig. 5.—Basal view of skull No. 1.
Fig. 6.—Lateral view of skull No. 2.

PLATE 26.

Fig. 7.—Frontal view of skull No. 2.
Fig. 8.—Occipital view of the same.

PLATE 27.

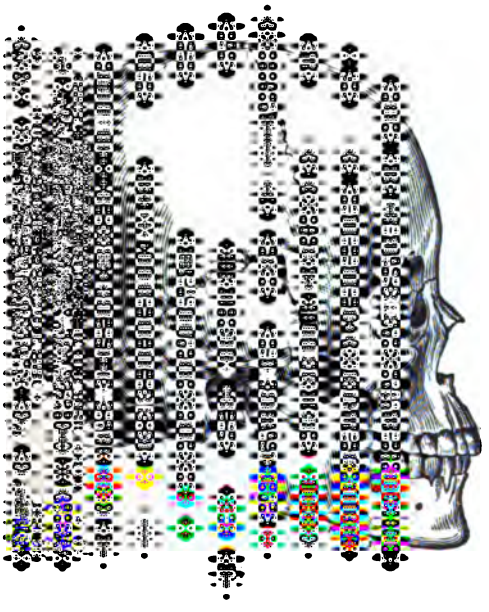
Fig. 9.—Vertical view of skull No. 2.
Fig. 10.—Basal view of the same. Owing to the faulty shading of the occipital region, the occipital bone does not appear to turn upward as abruptly from the posterior margin of the great foramen as it actually does.

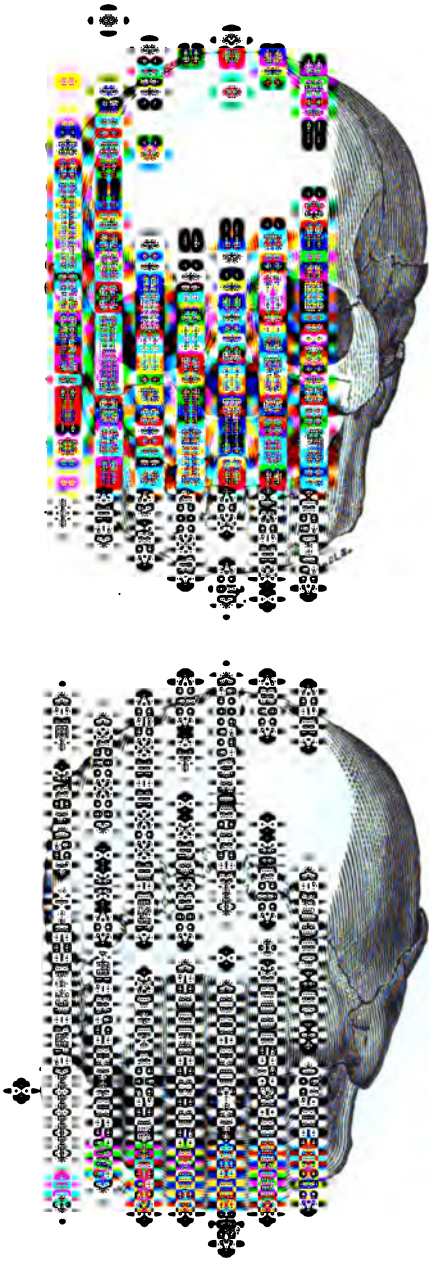
PLATE 28.

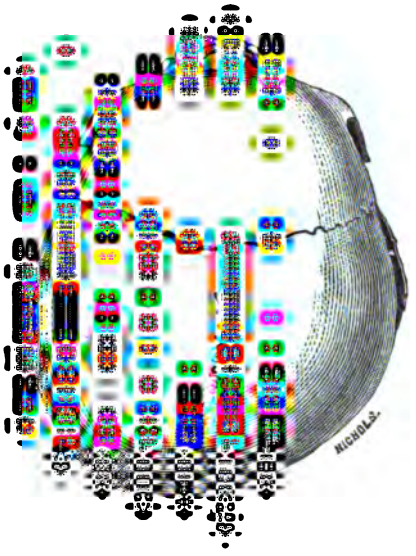
Fig. 11.—Frontal view of skull No. 3.
Fig. 12.—Vertical view of the same.

PLATE 29.

Fig. 13.—Lateral view of skull No. 3.
Fig. 14.—The heaviest outline of the diagram represents a profile-view of skull 1179 (Catalogue U. S. A. Med. Museum) from Abiquiu. The less heavy line represents the same view of a Guatemala Indian, No. 276 of the catalogue, and referred to on page 56, while the dotted line represents the profile of a Peruvian, No. 250 of the catalogue, and mentioned on the same page.



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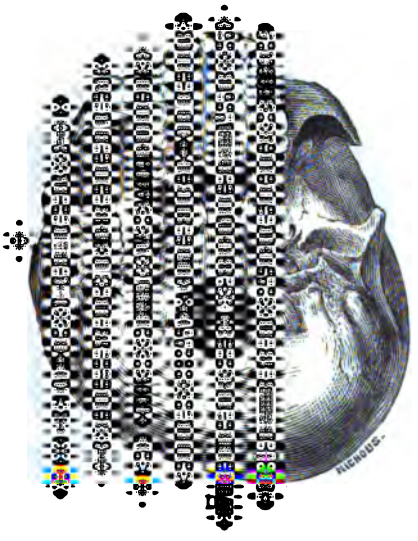
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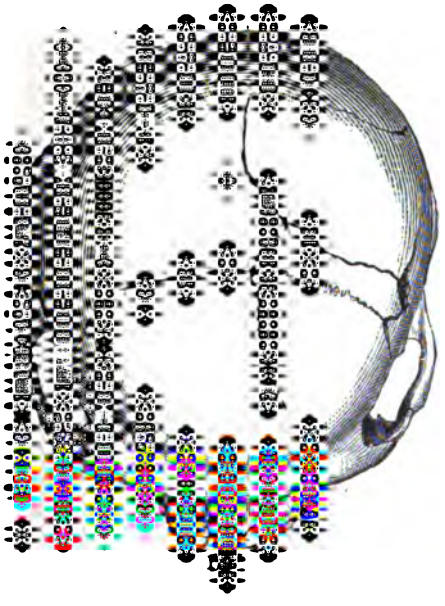

ANCIENT ART IN NORTHWESTERN COLORADO.

By Edwin A. Barber.

The great wilderness which stretches through North and Middle Parks of Colorado, and westward along the valleys of Bear (Yampa), White and Grand Rivers, once composed the hunting-grounds of the ancient ancestral branches of some of the present western Indian tribes. Even now, deer, elk, antelope, bear, and Rocky Mountain sheep are very abundant, and it has not been more than thirty years since the buffalo or mountain bison roamed the river-bottoms, as is evident from the character and appearance of the old "buffalo-wallows" which still are to be seen in the vicinity of White River agency. In the elevated boundaries of North Park an old bull bison was seen in August of 1874; so that centuries ago, it is reasonable to suppose, these animals congregated on this portion of the western slope of the Rocky range. Throughout this whole extent of territory, traces of primitive art abound, which, although not met with in great abundance in concentrated localities, are, nevertheless, scattered sparingly over this entire country. During the summer of 1874, the writer, in connection with the United States Geological Survey, collected a number of interesting forms of stone implements, principally arrow-points, some of which are here noticed. Along the banks of Willow Creek, in Middle Park, were found several delicate and minute specimens of singular forms. Among these were a few very rude patterns chipped from carnelian and chalcedony.

In North Park a number of perfect points were picked up, which, in some instances, varied somewhat from anything before discovered in this section.

One was a peculiar form, fashioned nicely from a very beautiful lavender-colored flint, with red spots throughout. The specimen is noticeable for its perfect symmetry and entireness.

There were also two specimens of different shapes, obtained in the valley of the Yampa River. In this bottom I found a spot on the top of a lofty mass of white sandstone, where arrow-heads had once been manufactured. Here were accumulated flakes of flint, agate, quartz and jasper, in great quantities, and among the chippings were found several very minute specimens, entire and broken, some of them scarcely a third of an inch in length.

Another specimen is a red and white agate with small spots of delicate red moss on the right-hand edge. After the spear-head (for such it evidently was) had been broken, it was ground down flat where the fractures occurred; that is, where the point had been broken off and where the shaft joined the body, and put to further use, probably as a cutter or skin-scraper, for it is admirably adapted to either of these uses. The side edges are chipped exceedingly thin and sharp, so that in all probability the broken spear-head was turned into a knife.

I picked up also a corresponding instrument of the same character, made of a very dark, mottled flint. It was not altered after having been broken, as may be seen by the fractured upper edge; but the rounded lower edge is sharpened, though not so acutely as the sides of the preceding.

A large spear-head shaped from a flinty, light gray sandstone, was found on the plains near Denver.

An interesting specimen is the bottom of a steatite dish or bowl, evidently once designed for heating water. It is elliptical, the axes being respectively 5 and 3½ inches. The upper portions of the brim have been broken away, and the sides which remain, measure only about 2 inches in height. The specimen was dug up recently on the Denver plains.

In Southern Colorado many implements were picked up during the summer of 1875, and in one locality, near Rosita, I discovered another spot where arrows had been manufactured. In describing it I will quote from the New York Herald of July 3, 1875:

> About six miles from Rosita (to the north), on the hillside on which we encamped, were picked up various pieces of stone weapons of all forms and made of many different kinds of rock. From the appearance of these fragments it may be inferred that this was once a locality where they were manufactured, as no perfect specimens were obtained, all being unfinished or imperfect. We found several here in a half-finished condition.

These, together with those described above, were undoubtedly made by the ancient Ute Indians, and some, probably, by the old Arrapahoes.

BEAD ORNAMENTS, EMPLOYED BY THE ANCIENT TRIBES OF UTAH AND ARIZONA.

By E. A. Barber.

Among the adornments of all aboriginal tribes of men are found many varieties of beads, which have been cut or ground from wood, bone, horn, stone, or shells. Those made of various species of the latter predominate, the marine shells, such as the *Busycon*, *Marginella*, *Oliva*, *Fasciolaria* and many other genera, being the most common. The prehistoric people of Arizona, New Mexico, Utah, and Colorado employed in their personal decoration at least *two* genera, of which were discovered by the Photographic Division of the United States Geological Survey, several species.

All the bead ornaments found in this secton of the great West may be classed under four heads:

I. Shells.
II. Earthen-ware beads.
III. Turquoises.
IV. Pendants:
  a. Of stone.
  b. Of pottery.

The marine shells which were converted into beads by this ancient tribe, so far as has been proved by the investigations of the Survey during the summer of 1875, were the *Oliva* and, probably, the *Busycon* or *Murex*. Of the former genus, we were so fortunate as to discover at least one species. One specimen represents the *Oliva bi-plicata* (*probably*), although the shell is so weather-worn that most of the specific characteristics are almost entirely obliterated. Still it resembles this species of the Pacific coast strongly, and is very likely the same. This was not so common as the larger variety, which is possibly a more fully developed representative of the same species. The first samples of these shell-beads were taken from the site of an old ruin where they had been lying for centuries, until decomposition had left nothing but small fragments of either extremity. Through eastern Utah, and south, into Arizona, many *Olivas* were found scattered through the *débris* of crumbling walls and broken pottery. The perforation has been effected by grinding down the spire, so that a thong would pass through the shell lengthwise. Of the genus *Busycon*, or *Murex*, was found but one doubtful representative. The beads made from this were of two sizes and usually white. The smaller variety was flat on both sides, or slightly convex on one side and concave on the other, as thin as a wafer, and the circumference of an ordinary pea. In the centre a neatly bored hole enabled the owner to string the beads together in the form of a necklace. The larger variety was

about the circumference of an average buck-shot. Such beads were evidently held in great esteem by the people, and among the ruins they are extremely rare, only two or three specimens having been found. Captain Moss, of Parrott City, Colo., who has spent much time during the past few years among the ruins of this section, says that these beads are valued highly by the present Navajo Indians to the south, a small string, when such can be found, bringing a good horse in exchange. The Navajoes are constantly grubbing among the ruins and ancient graves in search of these trinkets; and this accounts for their great scarcity among the ruins to-day. They were undoubtedly obtained by the ancients from other tribes, who brought them, or at least the shells from which they were fashioned, from the Pacific coast. We know that these ruins extend as far west as the junction of the San Juan and Colorado Rivers, so that communication between this tribe and those along the Pacific Ocean was rendered easy.

Of the second class of bead-ornaments, many are found among the heaps of ancient pottery which surround all of the old ruined buildings. A small piece of pottery, generally of the best glazed and painted ware, is taken, and the edges ground down into a circular or rectangular form, varying in size from a third of an inch to an inch in diameter, or from a half inch to an inch and a half in length. The circular specimens have perforations in the center, while the square or rectangular varieties have holes near one end. These latter may be classed with No. IV.

The third division is represented by but a single specimen, which was picked up during the month of August, 1875, in the Cañon of the Montezuma, in Utah. It is simply a piece of turquoise, flattened and polished on both sides, and is undoubtedly half of a bead, as is demonstrated by the orifice, at which place it has been divided. The hole was evidently bored by a stone "*rimmer*," as the opening on the top surface is much greater than that on the under. These turquoises, or the "*Chalchihuitls*" of the Indians, were obtained from the Los Cerillos Mountains in New Mexico, southeast of Santa Fé. Here is a quarry which was worked probably before the arrival of the Spaniards in this country, and it was here, undoubtedly, that the ancient "cliff-dwellers" obtained their turquoise. Here probably their descendants, the Moquis, Pueblos, and Zuñis, procured the turquoises mentioned by the Reverend Father Friar Marco de Niça, in 1539, and by Francisco Vasquez de Coronado in his account of his visit to these people in 1540. Marco de Niça wrote: "They have emeralds and other jewels, although they esteem none so much as turquoises, wherewith they adorn the walls of the porches of their houses, and their apparel and vessels; and they use them instead of money through all the country."

The fourth and last class of bead-ornaments consists of all those trinkets, made usually of stone or silicified wood, but occasionally of pieces of pottery, which were employed in decorating ear-rings or necklaces. These are usually flat, neatly-polished, rectangular pieces, with the aperture bored through one end. They vary from half an inch to two inches in length, the width being usually about two-thirds of this, and from one-sixteenth to one-eighth of an inch in thickness. The form graduates from the rectangular to the elliptical, as the corners are more or less rounded or worn.

These were suspended either from circular eardrops, made mostly of shell, or from the front center of necklaces. Some such ornaments as these are still worn among the Mojaves, Moquis, Pueblos, and Zuñians of Arizona and New Mexico. This style of perforated orna-

ment was the most abundant of all the varieties which may be classed among the *bead-work* of the ancient people of the West.

In this connection I will take the liberty of mentioning the shell ear-rings, which were manufactured with much labor and worn by the same people. One single fragmentary specimen was discovered by the party, but it is sufficient to show its use, and was probably a representative of the commonest form. The circlet was cut from a whorl of a marine shell, most probably the *Murex.*

As shown by the arc of the circumference of the specimen, it was originally one and five-eighths inches in its outer diameter. To such ear-drops as this the pendants of Class IV were attached.

Such points will be valuable in tracing the communication and relationship which existed probably a thousand years ago between these ancestors of the modern Moquis, Pueblos and Zuñis with other ancient tribes of the East or West. The Moquis at this day still have remnants of many of these trifles of their forefathers, herein described.

LANGUAGE AND UTENSILS OF THE MODERN UTES.

By E. A. Barber.

Each distinct Indian tribe possesses its individual characteristics and peculiarities, different from all others; and, although neighboring tribes may resemble each other in certain mutual well-established customs, there are always minor points of difference in language, habits, the forms of weapons, or peculiarities of dress; and by these points an individual Indian may be recognized as belonging to a certain tribe, even should the observer be not sufficiently familiar with the savage physiognomy to class him by his facial characteristics. Among themselves, Indians possess a remarkable degree of discernment, being able to detect the most minute shades of difference in well-known objects, so that one can determine unerringly to what tribe another may have belonged from the sight of a single impression of a moccasined foot in the soil. So great is their acuteness of vision and proficiency in the interpretation of signs, that they readily distinguish objects and their kind at so great a distance that unaccustomed eyes can discover nothing. To the eye of the inexperienced in such matters, a stone arrow-head, in whatever section of the West it may have been picked up, would present the appearance simply of an Indian relic; but when exposed to the gaze of a warrior, it is immediately recognized as having been used by a certain tribe.

This is the more wonderful for the reason that stone weapons have entirely disappeared from among them, the stone heads, which were perhaps fashioned more than half a century ago, being now replaced by iron-pointed arrows, feathered on the wooden shaft.

The White River and other bands of the Ute tribe herein described, occupy a reservation which, in the words of the treaty, is described thus:

Articles of a treaty and agreement made and entered into at Washington City, D. C., on the second day of March, 1868, by and between Nathaniel G. Taylor, Commissioner of Indian Affairs, Alexander C. Hunt, governor of Colorado Territory, and ex-officio superintendent of Indian affairs, and Kit Carson, duly authorized to represent the United States, of the one part, and the representatives of the Tabaquache, Muache, Capote, Weeminuche, Yampa, Grand River, and Uintah bands of Ute Indians (whose names are hereto subscribed), duly authorized and empowered to act for the body of the people of said bands, of the other part, witness:

* * * * * * *

Art. II. The United States agree that the following district of country, to wit, commencing at that point on the southern boundary-line of the Territory of Colorado where the meridian of longitude 107° west from Greenwich crosses the same; running thence north with said meridian to a point fifteen miles due north of where said meridian intersects the fortieth parallel of north latitude; thence due west to the western

boundary-line of said Territory; thence south with said western boundary-line of said Territory; thence east with said southern boundary-line to the place of beginning, shall be, and the same is hereby, set apart for the absolute and undisturbed use and occupation of the Indians herein named, and for such other friendly tribes or individual Indians as, from time to time, they may be willing, with the consent of the United States, to admit among them; and the United States now solemnly agree that no persons, except those herein authorized so to do, and except such officers, agents, and employés of the Government as may be authorized to enter upon Indian reservations in discharge of duties enjoined by law, shall ever be permitted to pass over, settle upon, or reside in the territory described in this article, except as herein otherwise provided.

They cannot be said to possess a language, but rather a *jargon*, composed, for the most part, of guttural sounds, mingled with words from the Spanish and English. The jargon is dialectic, as may be proved by the fact that distant branches of the same general tribe use many words which are not intelligible to each other. It is a very erroneous idea, harbored by many in the East, that all of the Indian tribes west of the Rocky Mountains employ but one language peculiar only to the American race. On the contrary, however, there exist as many Indian dialects as there are distinct tribes. If we find such discrepancies in the same or neighboring tribes, is it not probable that distant tribes are much more apt to differ in this respect? Such we find is the case, for the Navajoes and Utes, although on the most friendly terms, are unable to understand each other, having scarcely a word in common, although they are located within one hundred miles of each other. Last summer, (1874,) a delegation of Navajoes visited the Utes at the White River agency, Colo., for the purpose of trading their blankets for ponies, guns, &c., and it was only through a Spanish interpreter that they were enabled to effect their trading, the Spanish language being an intermediate link between the two dialects. In dress these nations, if we may so call them, differ considerably, the Navajoes wearing simply a shirt, loose, short breeches extending to the knee, a blanket, leggings, moccasins, ornamented usually with little or no bead-work, and the head bound with a cloth or bandana. In this connection it may be well to briefly allude to the Navajo blankets.

The Navajoes, being a semi-civilized tribe, devote much of their attention to sheep-raising in New Mexico, and from the wool they manufacture blankets which, for durability and impenetrability of water, far surpass anything of the kind made by civilized methods, and in the arrangement of their very durable coloring an unusual degree of taste is displayed. The hand-made blankets are very heavy, perfectly waterproof, and the finest work very beautiful, bringing, in some instances, as high a price as $500.

The languages of the North American Indians have, perhaps, scarcely reached a higher degree of perfection than existed at the discovery of America; or, if they ever improved, they have retrograded to the same state of imperfection, for it has become a proverbial idea that the Indian makes no advances, no improvements, no new discoveries, but follows continually in the footsteps of his forefathers. It will be seen, then, that the savage mode of expression is at present very little in advance of the primary forms of language. The human speech is supposed to have commenced in the formation of nouns, consisting merely in the naming of external objects, and as man's wants increased and his mind was developed, adjectives next came into use, and so on down to the least important part of speech. The language of the Utes stands on a footing of equality with that of other Indian tribes, and being simply a *spoken* language, it is difficult to represent the

sounds on paper. To give an idea of it, this short list of words may suffice:

NOUNS.	NOUNS.	NOUNS.	NOUNS.
Bab-bitz',	Brother.	Moo'-rets,	Mule.
Poor-ah',	Arm.	Po'-kent,	Letter, paper.
Pwap,	Blood.	Pin-ah'-ka,	Money.
Wan'-zitz.	Antelope.	Pan-tchook',	Otter.
Ker-mush',	Another.	Pis-ah'-nee,	Name.
Pow'-inch,	Beaver.	Sah'-up,	Reed-couch.
Moo'-sets,	Wild-cat.	Tab'-by,	Sun.
Sar-rich',	Dog.	Way'-tchook,	To-morrow.
Tig'-a-boo,	Friend.	Quap,	Tobacco.
Tu-shu'-kent,	Flour.	You-oge',	Wolf.
Weetch,	Knife.	Em,	You.

The Ute possesses less of that attributed and historical stolidity of countenance and sparing use of speech which is supposed to characterize the general race, for, in reality, his face, as a rule, is expressive and changeable, and his conversational powers are constantly exercised to the utmost. In listening to the unintelligible jargon of these Indians, one would scarcely believe it possible that the language contained so many euphonious proper nouns. Such names as Ne-va'-vah, Un-kan'-a-wah-wich, Soc'-a-witz, Pin-on'-as, Un'-ga-torts, Nu'-ga-muntz, Sar-rich', Mav'-a-rich, Su'-ri-ap, Pa'-ant, &c., have an unmistakable Indian origin, which cannot be imitated in the beauty of sound by any proper names in the English geography or the American household.

At the head of this band is a chief who goes by the name of Douglas, but whose Indian name is *Quin'-cor-ruck'-unt.* Jack, (*Nick-a-a'-gah*, which means *Green Leaf*,) is one of the head war-chiefs; not the notorious Captain Jack of the Modocs, but a Captain Jack fully as treacherous, though with a milder reputation, awaiting but the favorable opportunity to perform as atrocious, but less dangerous to himself, deeds of blood.

Although the Utes, as a rule, disparage the innovations of the whites, there are some few exceptions, who seem to rise above the petty jealousies of ignorance and superstition, and, in accepting the improvements of civilization, view with a degree of contempt the stationary barbarism of their fellow-men. Such a man is "*Chinaman's Brother.*" From his first contact with the whites he has gradually been growing dissatisfied with the unprogressive character of his race, by imbibing some of the more advanced principles of civilization; and although some of the natural proclivities of the Indian still cling to him, he has advanced a step beyond his tribe in industry and improvement. At the White River agency a log hut was erected for the convenience and shelter of those Utes who happened to return from the hunt during the winter season. "Chinaman's Brother" has monopolized this house for his own family, and, in a very un-Indianlike manner, ornamented the premises with shrubs, out-houses, and extemporaneous seats.

Despite his earnestness and zeal to advance, "Chinaman's Brother" is by no means a scientist or philosopher. Entering one day one of the agency buildings, where some alcoholic specimens of snakes and newts were being changed by a scientific party, the characteristic inquisitiveness of the Indian asserted itself as he watched the operation, and in broken English he asked "What you do?" Being answered that the snakes were to be sent to Washington, he very innocently replied, "Ump! Washton eat um? Heap like um?" It was impossible to make him understand the principle on which scientific collections were made, and

he left, muttering something to himself which sounded like "Him no eat um! Washton no like um!" In the fine arts this tribe has not advanced beyond the first rude attempts at drawing and painting. Yet in almost every lodge, the talent of the artist is displayed upon the canvas in the painting of animals and the representation of historical battles.

On one tent the figures were supposed to chronicle a memorable fight with the A-rap'-a-hoes, and represent the horses and trophies captured from them on that occasion. Not being able to write, this is the only method of recording historical events. The colors used in the production of these paintings are applied indiscriminately, with the same disregard to nature as the *parts* of the figures are disproportionate. Usually the horses are green, blue, or yellow, and the most gaudy hues are daubed over everything.

An Indian in his aboriginal state invariably rides bare-backed, but gradually, of late years, saddles have been finding their way among the different tribes, and the Utes are adopting them whenever they can obtain any. In the absence of regular saddles they make very rude ones, particularly for the squaws and for pack-saddles. A squaw rides as a man, and it is a matter of wonder that she can keep her seat for so long a time on such an angular, hard, uncomfortable contrivance. These saddles are made of wood, covered with parchment or stiff skin, and over them blankets are laid to make them endurable. The stirrups have a very antique appearance, and are constructed of thin pieces of wood, covered with raw-hide.

In their domestic arrangements the American Indians have little need for many culinary utensils. An iron pot or kettle hung over the fire on poles, a couple of water-vessels, and some wooden bowls are the extent of the cooking implements. The water-vessels are made after the shape of some used by the ancients, and are woven out of willow twigs. The interior is coated with gum or pitch and thus is rendered water-tight. At almost any time of the day can an Indian female be seen wending her way to the river, Rebecca-like, with her vessel carelessly thrown over her shoulder.

Most of the young bucks are vain and fond of show. Ornaments and trinkets are profusely spread over their dress, and dandies among the savages are as common as in our cities. An ornament which is worn generally among the better classes, is in the shape of a cap-box, in which gun-caps are carried. This is suspended upon the breast by a bead neck-lace passing around the neck. Beads, ear-rings, brass tacks, wampum, rings, and other gew-gaws are stuck on their persons in every available place. Resulting from a depraved superstition, a medicine-sack is absolutely indispensable to the personal safety of each and every brave. This wards off sickness and calamity, in the absence of which, pain, death, and the devil would rule supreme. These medicine charms are of various forms to suit the taste of the wearer. They are usually leather or skin sacks, an inch or two in diameter, beautified with beads and filled with sulphur, red powder, or any other substance supposed to possess an omnipotent charm. They are usually worn by a string, on the breast.

The pappooses resemble their white brothers and sisters in their natural dispositions and amusements. The smaller Indians play, laugh, cry, and act precisely as other children, and toys are as much a necessity with them as with our little ones. Near one lodge I picked up a mud-horse with wooden legs, made by a small pappoose; and in this respect, these children possess, perhaps, more ingenuity than those having greater advantages; necessity being the mother of invention.

A cụn (pronounced as the ụ in cushion) corresponds with our cradle. The squaw makes this out of wood and buckskin. The back is hewn from a board and then covered with skin. Then the pouch is formed of the proper size and shape and so arranged that when the child is laid in, the flaps are laced tightly down the front, so that it may be fixed immovably in it. Above the baby's head is always a little wicker-work awning into which it fits loosely, and day or night the arrangement, pappoose and all, is leaned up against the *wick'-e-up*, and the infant is only removed from its coffin in cases of necessity. The squaw carries this on her back on journeys, though she go afoot or on horse-back, and it is secured by a strap passing across her breast. When the little one cries, it is gently swayed from side to side by the mother, and the soothing motion soon rocks it to sleep.

One of the greatest luxuries of the Ute toilet is the Turkish bath. It is such a rare thing for an Indian to perform his ablutions, that when he does so it is considered a great occasion, and must be done in no ordinary way. In fact, scarcely anything but sickness can prevail upon a Ute to wash himself, and perhaps three-fourths of the tribe never apply water to their external bodies. The bath is constructed and used in the following manner: A frame-work of poles is set up in the shape of a hemisphere, the base being perhaps six feet in diameter. This skeleton is covered with blankets, robes, and skins, in order to bar out the gaze of profane eyes. In the center of this dome-shaped apartment a cylindrical hole is dug in the earth to the depth of about two feet, and six or eight inches in diameter. In the bottom of this a fire is built, and when several inches of the excavation are occupied with hot coals, the hole is filled to the top with stones, which soon become heated and ready for use. The patient then disrobes, and, standing or sitting over the bath, pours a bucket of cold water upon the stones, which generate steam; and thus, surrounded by a cloud of vapor, the Indian enjoys to the fullest extent what might be called a primitive Turkish bath.

The bone whistle which I obtained, was captured from the Arrapahoe Indians, by the Utes, in a skirmish at Pine Grove, Wyoming Territory. It is decorated with bunches of human hair tied to the otter-skin trimmings. The necklace is made of grizzly bears' claws, fastened on a band of leather which is covered with bead-work. The necklace has been used in the tribe for several years, and was at length bought from an old man into whose possession it had fallen.

Vocabulary of Ute (Yampa) words.

ENGLISH.	UTE.	ENGLISH.	UTE.
Arm.	Poor-ah'.	To-morrow.	Way'-tchook.
Blood.	Pwap.	Yes.	Oo'-ah.
Friend.	Tig'-a-boo.	No.	Katsh.
Knife.	Weetch.	One.	Su'-is, or su'tis.
Tobacco.	Quap.	Two.	Wy'-une, or wine.
Sun.	Tah'-by.	Three.	Pi'-une, or pine.
Water.	Pah.	Four.	Wa't-shu-e'-nee.
Dog.	Sar-rich'.	Five.	Man'-i-gin.
Wolf.	You-o'ge.	Six.	Na-vine'.
Beaver.	Pow'-inch.	Nine.	Sur-rom'-su-e-nee.
That (one).	Inch.	Ten.	Tom'-shu-e-nee.
Name.	Pis-ah'-nee.	Forty.	Wat-shu-e'-nee. Tom'-shu-e-nee.
Black.	To'-quer.	Fifty.	Man'-i-gin. Tom'-shu-e-nee.
Small.	May'-pootz.		
You.	Em.		
All.	Mah-no'-nee.		

Vocabulary of Ute (Yampa) words—Continued.

ENGLISH.	UTE.	ENGLISH.	UTE.
Sixty.	Na-vine' tom'-shu-e-nee.	To sell, trade.	Nar'-ro-wap.
Ninety.	Sur-rom'-su-e-nee tom'-shu-e-nee.	To understand.	Pe-su'-ge-we'-ah.
To see, look.	Poon'-e-kee, or Boon'-e-kee.	All gone, gone away.	To-pic'-quay, or Katsh-kar'-ra.
To go.	Pi'-e-quay.	Brother.	Bab-bitz'.
To come.	Pi-e'-ka, or Pe-jee'.	Indian cradle.	Cûn.
Antelope.	Wan'-zitz.	Flour.	Tu-shu'-kent.
Another.	Ker-mûsh'.	Letter, paper.	Po'-kunt.
Wildcat.	Moo'-sets.	How many?	Ah'-na-pine?
Mule.	Moo'-rets.	In the future.	Pe-nu'nk.
Otter.	Pan-tchook'.	In the past.	Wee'-tish.
Willow couch.	Sah'-up.	Money.	Pin-ah'-ca.
		Salutation.	Mike tig'-a-boo.
		Button.	Pe-tu'-na.

FOSSIL COLEOPTERA FROM THE ROCKY MOUNTAIN TERTIARIES.

By Samuel H. Scudder.

In this paper are made known the first fossil Coleoptera from the Tertiaries of the United States; indeed, if we except some doubtful remains found in the red sandstone of the Connecticut Valley, the first distinctively American Coleoptera from any formation. Two beetles have been figured by Heer from the Miocene of Northern Greenland, and these are all that have yet been described from the New World. The preliminary descriptions here presented* are published in the hope of drawing attention to the rich deposits of the West, which will doubtless prove as fertile as those of Europe. Most of the species have already been drawn for plates which I hope soon to publish in a general work on the fossil insects of the American Tertiaries, to accomplish which the assistance of those who may be able to make collections in the Rocky Mountain region is earnestly solicited.

In the determination of the generic affinities of these insects I have been greatly assisted by the kind advice of my esteemed friend Dr. J. L. LeConte, although he is in no way to be held responsible for any errors I may have committed in studying a group of insects less familiar to me than are others. I am also indebted to Mr. E. P. Austin for the use of his rich collection of American Coleoptera and for assistance in other ways.

Descriptions of the other groups of insects will follow from time to time.

Bembidium exoletum.—A single, rather well-preserved specimen, exhibiting the upper surface and impressions of parts of the legs, was found by Prof. W. Denton (the first discoverer of Tertiary insects in America) in the Green River group, near White River, in one of the two localities called by him Chagrin Valley and Fossil Cañon. It is about the size of *Bemb. inæquale* (Say). The head is too poorly preserved to present any characters; the pronotum is of equal width anteriorly and posteriorly, its sides regularly and considerably convex, the posterior angles well defined, the hind margin slightly convex; its surface appears to be very faintly punctulate, at least posteriorly, and there is a slightly impressed median line. The elytra are shaped as in *B. inæquale* and are provided with seven or eight very delicately impressed longitudinal striæ, made up apparently of a series of adjacent punctures; the sutural edge is delicately marginate. The fragments of legs show simply that they are of the form usual in Bembidium.

Length of insect 4.75^{mm}, of pronotum .88^{mm}; width of same in the middle 1.2^{mm}; of same at the posterior border 1^{mm}; of the body at the

*For previous general accounts of the collections of Professor Denton and Mr. Richardson, upon which the following descriptions are principally based, see: Proc. Bost. Soc. Nat. Hist., x, 305, 6; xi, 117–8. Amer. Nat., i, 56; vi, 665–8. Geol. Mag., v, 220–2 Hollister, Mines of Colorado, 378–87.

humeral portion of the elytra 1.6^{mm}; of same at the middle of the elytra 2.06^{mm}; length of the elytra 2.8^{mm}, of fore femora .96^{mm}; breadth of same .24^{mm}; length of hind femora (?) .92^{mm}; breadth of same .36^{mm}; distance apart of the elytral striæ .11^{mm}.

2. *Laccophilus* sp.—A fragment of a leg found by Professor Denton in Fossil Canon, White River, must be referred to this genus. It represents the hind femur and tibia of a species allied to *L. maculosus* Germ., but is so uncharacteristic a fragment that it is not worthy of further mention.

3. *Philhydrus primævus.*—A single specimen, wanting head, thorax, and legs, but exhibiting at once the upper and under surface of the body, (like specimens mounted after a potash bath,) was found by Mr. F. C. A. Richardson, five miles west of the Green River on the line of the Union Pacific Railroad, in Wyoming. The elytra taper on the apical third, following the narrowing form of the abdomen, and are delicately pointed; they are furnished each with six straight equidistant rows of distinct longitudinal punctate striæ, 0.19^{mm} distant from one another.

Length of elytra, 3.8^{mm}; breadth of same, 1.35^{mm}.

4. *Staphylinites obsoletum.*—A single specimen was obtained by Mr. Richardson in the Green River bed at the same locality as the preceding. It is too poorly preserved to determine, until further material is obtained, to what genus of Staphylinidæ it should be referred. Following, therefore, the lead of Professor Oswald Heer in similar cases, it is referred to a provisional genus Staphylinites. The head, thorax, and abdomen are of equal breadth; the eyes are round and rather large; the posterior border of the pronotum is well rounded; the elytra are simple, about twice as long as broad, truncate and very broadly rounded, with a large roundish, very dark spot occupying the whole of the tip.

Length of fragment, 3.25^{mm}; breadth of same, 1.25^{mm}; diameter of eyes, .45^{mm}; length of elytra, 1.25^{mm}.

5. *Gyrophæna saxicola.*—A single specimen of a species allied to *G. vinula* Er. was found by Professor Denton in Chagrin Valley, White River. The head is well rounded, with large round eyes and a rounded labrum. The prothorax is but vaguely defined on the stone, and is apparently of about equal breadth with the head, and shorter than broad. The elytra are of equal length and breadth, each with a pair of longitudinal, straight, delicate raised lines. There is no sculpturing of the surface; no wings can be seen, nor legs, and the indistincly preserved abdomen is shaped as in *G. vinula.*

Length of body, 1.84^{mm}.

6. *Leistotrophus patriarchicus.*—A single greatly-crushed and ill-defined specimen was obtained by Professor Denton at one of the localities explored by him on the White River near its junction with the Green. Above, the head is broader than long, the front very broadly and regularly rounded, the jaws projecting triangularly beyond it; the eyes are large, nearly as long as the head and just as long as the width of the space between them; the whole head is minutely and uniformly granulate. The collar, which is not granulate, is of the same width as the part of the head between the eyes, and about half as long as the head; on one side of, and in direct connection with this are some crushed fragments, apparently of one of the fore coxæ and femora, which distort its appearance. The prothorax is of about the size of the head, quadrate, with rounded corners and a slight elevated rim, without punctures or granulations. The elytra are very short, broader than long, quadrate,

squarely docked at the tip, leaving no signs of an exposed scutellum, faintly and distantly punctulate. The outline of the middle coxæ is impressed through the remains of the insect, showing them to be shaped as in Creophilus and Leistotrophus. The abdomen is as broad as the thorax, not much longer than broad, broadly rounded apically, furnished with hairs on the upper surface and apical tufts as in *Creophilus villosus* (Grav.); there are, however, no signs of punctulation.

Length of fragment 12^{mm}, of head 2.5^{mm}; breadth of same, 3.75^{mm}; length of eyes, 2^{mm}; breadth of same (as seen from above), .88^{mm}; length of tegmina, 1.75^{mm}; breadth of same, 2^{mm}; breadth of abdomen, 3.8^{mm}; length of middle femora, 2.3^{mm}; breadth of same, .65^{mm}; length of middle coxæ, 2.5^{mm}; breadth of same, 1.1^{mm}; length of hind femora, 2^{mm}; of hind tibiæ, 2.5^{mm}.

7. *Lathrobium abscessum.*—Two fragmentary specimens were taken by Mr. Richardson five miles west of Green River Crossing, Wyoming. The head is smooth, subquadrate, broader than long, with slightly convex sides and hind border, the eyes of medium size, obovate, a little in advance of the middle of the head. The prothorax is smooth, as broad as the head, shaped quite as in *L. elongatum* (Linn.), the sides straight, the anterior angles rounded off, the whole posterior border well rounded. The abdomen is also as in the species mentioned, with rounded tapering tip, but the elytra are shorter, being barely as long as the prothorax, with rounded apices.

Length of body 6.25^{mm}, of head .96^{mm}, of eyes .25^{mm}; breadth of head 1.02^{mm}; length of prothorax 1.16^{mm}, of elytra 1.05^{mm}; breadth of abdomen 1.2^{mm}.

8. *Oxytelus pristinus.*—A single fairly preserved specimen, but of which none of the appendages excepting the elytra are visible, was found in Chagrin Valley, White River, by Professor Denton. Apart from the labral prolongation, which is as in other species of Oxytelus, the head is subquadrate, slightly broader than long, the eyes occupying the whole lateral outline and but little convex; the sutural divisions of the under surface show through upon the upper surface (which is exposed to view), obscuring somewhat the parts above. The prothorax is somewhat injured, but was evidently subquadrate, a little broader than the head, nearly a third broader than long, the front border slightly concave, the outer margin a little convex, the posterior angles and posterior border exactly as in *Oxytelus rugosus* (Grav.); the surface is delicately punctulate as in the species named, and there is a very slight, shallow, and broad median longitudinal sulcation, whose walls, however, are not elevated into ridges, as usual in the species of Oxytelus. The right elytron is expanded, and is, therefore, in the most favorable position for examination; it is more than half as long again as broad, the humeral angle well rounded off, the outer margin very gently convex, the apex squarely docked but slightly convex; the surface is covered rather profusely and uniformly with shallow circular punctures resembling those of the prothorax, and averaging about .04^{mm} in diameter. The abdomen is much as usual in Oxytelus, the sides slightly convex and the tip of the abdomen bluntly and rather regularly rounded; it was evidently furnished rather abundantly with very fine, short hairs.

Length of body 4.2^{mm}, of head .78^{mm}; breadth of same, 8^{mm}; length of eyes, .54^{mm}; breadth of same, .18^{mm}; length of prothorax, .72^{mm}; breadth of same, .9^{mm}; length of elytra, 1.22^{mm}; breadth of same, .75^{mm}; breadth of abdomen, 1.16^{mm}.

9. *Antherophagus priscus.*—Several specimens, representing either the upper or the under surface of the body, were obtained by Mr. Richard-

son west of the Green River Crossing, Wyoming Territory. They resemble *A. ochraceus* Melsh, in general appearance. The head is nearly as broad as the thorax and well rounded; the eyes are about circular, .11^{mm} in diameter; the mandibles are stout, about twice as long as their breadth at base, tapering but slightly; the labium is narrow. The prothorax is about twice as broad as long, smooth, the front border slightly concave above, rather strongly concave below, the sides gently and regularly convex, the anterior angles rectangular, the posterior less prominent, the hind border broadly convex. The prosternum and the other sternal portions of the thorax seem to be delicately granulose; the middle coxæ are about equidistant from the others, or perhaps slightly closer to the hind pair, and the fore coxæ are more closely approximated to each other than the others, being separated by less than their own width. The scutellum is small, scarcely longer than broad. The elytra are smooth, equal, tapering only near the tip, the extremity of each independently and roundly pointed.

Length, 3.2^{mm}; breadth, 1.65^{mm}; breadth of head, 1.05^{mm}; of prothorax, 1.53^{mm}; length of same, .75^{mm}; of elytra, 2.1^{mm}; breadth of same, .9^{mm}.

10. *Phenolia incapax.*—Represented only by a single specimen and its reverse from the Green River shales (Richardson), showing the under surface of the body, from which the appendages have been torn. It closely resembles, in size, form, and the relation of the parts, *P. grossa* (Fabr.), but differs from it in the character of the under surface of the body, which, in the fossil species, is very minutely and very faintly punctulate, and the posterior edges of the segments are not raised.

Length of fragment, 5.5^{mm}; of abdomen, 2.3^{mm}; breadth of same, 3^{mm}.

11. *Chrysobothris Haydeni.*—A single specimen, rather poorly preserved and obliquely crushed, was obtained by the United States Geological Survey of the Territories at Castello's Ranch, South Park, Colorado (No. 1722). While it is unquestionably a Buprestid, I place this species in Chrysobothris with some hesitancy. The shortness of the broad-tipped elytra, the rotundity of the eyes, and the comparatively slender fore femora separate it from the species of that genus which I have examined. The head is large, full, well rounded; the eyes moderately large, nearly circular; the prothorax is rather short, arched a little, minutely and shallowly punctulate. The elytra reach to the base of the penultimate abdominal segment, and, as exhibited on the stone, are as broad at tip as at base; the apex in any case is broad, broadly rounded or almost docked; there is no appearance of punctures, although there seem to be three or four faint equidistant longitudinal ridges. The legs are slender and the fore femora resemble the others.

Length of insect, 15.75^{mm}; of prothorax, 3.75^{mm}; of elytra, 10^{mm}; width of last at tip, 2.6^{mm}; length of fore femora, 3.25^{mm}; breadth of same, .56^{mm}; length of hind femora, 3.25^{mm}; breadth of same, 0.46^{mm}.

12. *Epiphanis deletus.*—A single specimen was brought from Fossil Canon, White River, by Professor Denton. On account of the structure of the antennæ and general resemblance of the insect to *Epiphanis cornutus* Eschsch, I have placed it in the same genus; but the form of the prothorax differs somewhat in the two species. The head is moderately large, subquadrate, the antennæ monilitorm, composed of twelve (preserved) equal joints. The thorax is nearly quadrate with straight sides, the front lateral angles rectangular, the front border straight or scarcely concave, the hind border slightly angulate; the elytra are slender and taper from the middle backward; they are too poorly preserved to show the markings.

Length, 5$^{mm.}$; breadth, 1.52$^{mm.}$; length of head, .94$^{mm.}$; breadth of same, .96$^{mm.}$; length of prothorax, 1.12$^{mm.}$; breadth of same, 1.24$^{mm.}$; length of elytra, 2.85$^{mm.}$; breadth of same, .76$^{mm.}$; length of antennæ, 1.6$^{mm.}$; of sixth joint of same, .13$^{mm.}$

13. *Corymbites velatus.*—A single specimen, with its reverse, was found by Mr. Richardson west of the Green River crossing, Wyoming. The head and prothorax are gone, but both upper and under surface of the rest of the body, including the elytra, may be seen in each impression with nearly equal distinctness. The insect appears to have been about the size of *C. medianus* (Germ.), but more closely allied in form to *C. splendens* (Ziegl.). The legs have been destroyed, but the middle and hind coxal cavities may be seen. The elytra are of the length of the abdomen, acutely angled, almost pointed at the tip, and furnished near the outer edge with a broad and shallow furrow, whose outer limit is abrupt and thus well marked. Besides this the elytra are faintly and distantly striate, with five or six rows of striæ, and the meso- and meta-sternum are very delicately granulate.

Length of fragment, 6^{mm}; breadth, 3^{mm}; distance between anterior edges of middle and hind coxæ, 1.75^{mm}.

14. *Oxygonus mortuus.*—A single elytron, and its reverse, were obtained by Professor Denton, at Fossil Cañon, White River. It is slender, the humeral angle well rounded, the outer edge apparently a little marginate; it is almost equal until near the tip, when it tapers to a point. This peculiarity leads me to refer it to Oxygonus, although the apex is not produced so much as in recent species of that group. It is furnished with eight equidistant, rather strongly-impressed but delicate striæ, that nearest the suture almost incroaching upon the margin; these striæ are equidistant anteriorly and in the middle, but posteriorly they converge toward each other.

Length of elytron, 4.55^{mm}; breadth, 1.72^{mm}; distance of striæ apart, .2$^{mm.}$

15. *Chauliognathus pristinus.*—A single specimen, with its reverse, was obtained by Mr. T. L. Mead at Castello's ranch, South Park, Colorado. It is very fairly preserved, and presents a dorsal view of the insect, with the left elytron and wing partially expanded. The head is rather small, rounded, the front extending considerably beyond the large eyes. The antennæ are about as long as the elytra, and apparently consist of twelve joints, most or all of which are similar to one another, cylindrical, about three times as long as broad, and scarcely smaller at the basal than at the distal extremity. The prothorax is small, scarcely larger than the head, the anterior border rounded. The elytra are slender, square at the shoulder, each independently rounded and slightly tapering at the apex, not reaching the tip of the abdomen. The abdomen, which tapers posteriorly, appears, however, to be unnaturally produced; more than four segments can be counted beyond the unexpanded elytron. The wings are as long only as the elytra; the legs are slender, but the tarsi are indistinguishable. But for the brevity of the elytra, there would be little doubt that this insect should be referred to *Chauliognathus*. It has the general appearance, also, of a *Malthinus* or a *Malthodes*, but the wings are not exposed when the elytra are closed, and the insect is much larger than the living species of these genera. Heer has described, from Oeningen and Radoboj, several Telephoridæ, but none so large as this, unless it be his *Telephorus Germarii*. Our species has much the general appearance of his figure of *Lytta Æsculapii*, but the structure of the antennæ forbids its reference to that group.

16. *Sitodrepa defuncta.*—A single elytron, with its reverse, was found by Mr. Richardson west of the Green River Crossing, Wyoming. It is very poorly preserved, more than twice and a half as long as broad, equal until near the tip, which is rounded off; it is traversed by eight or nine very slightly impressed and delicate punctate striæ, .1^{mm} apart.

Length, 2.75^{mm}; breadth, 1.06^{mm}.

17. *Spermophagus vivificatus.*—Two specimens, reverses, but one showing more plainly the upper, the other the under surface, were brought by Mr. T. L. Mead from Castello's ranch, South Park, Colorado. They are in an unusually good state of preservation. But very little of the small head can be seen, either upon the upper or the under surface; the portion exposed is delicately punctured, the punctures being closely crowded, and rather less than one-hundredth of a millimeter in diameter. The antennæ show nine joints, which are together longer than the breadth of the prothorax; the first and second joints are ovate, the remainder more or less obconical; the first four are of nearly equal length, and of about the same length and breadth; beyond, the joints are subequal among themselves, but much longer than broad. The prothorax is crushed, and although not misplaced, it is difficult to determine its exact form, or whether or not it wholly concealed the head from above. It is more coarsely punctate than the head, the punctures being .025^{mm} in diameter; the posterior border is broadly angulate, the angle rounded, the outer margin more or less rounded, and the whole prothorax broadest posteriorly. The elytra are very ample, equal, each independently, very broadly and regularly rounded at the apex, which does not reach the tip of the abdomen; they are very distinctly but narrowly punctato striate, in nine straight, equidistant complete rows, besides an auxiliary row next the outer margin, for a portion of the distance; near the tip of the wing, the outer and inner rows curve toward the middle of the apex, and all fade out before reaching it; the entire border of the elytra is marginate. The femora, especially the hind pair, are stout; the hind tibiæ are considerably shorter than the femora, and there are apparently, on one side, faint indications of the two long tibial spurs, with which the apex of the hind tibiæ are armed in this genus. The abdomen is exceedingly short and broad, the apical segment protruding a little beyond the others and well rounded.

Length, 5.25^{mm}; breadth of prothorax, 2^{mm}; of body at middle of elytra, 3.25^{mm}; length of antennæ, 2.2^{mm}; of elytra, 3.75^{mm}; breadth of same, 1.35^{mm}; length of middle femora, 1.05^{mm}; breadth of same, .28^{mm}; length of hind femora, 1.56^{mm}; breadth of same, .48^{mm}; length of hind tibiæ, 1.02^{mm}; distance apart of elytral striæ, .265^{mm}.

18. *Bruchus anilis.*—A single specimen was brought by Professor Denton from Chagrin Valley, White River. It consists of two elytra, in natural juxtaposition seen from above. They have a brown color, which is wanting in certain places, but in so irregular a manner that it is doubtless fortuitous; they are furnished with striæ, but these, as well as all color, are entirely obliterated in the middle of the wing; this again is doubtless a defect of preservation, since the sutural edges of the elytra are similarly affected; the striæ are deep, sharply cut, straight, subequidistant, eight in number, fading out at the apex of the elytra, the space between them smooth and arched.

Length of one elytron, 5^{mm}; breadth of same, 1.9^{mm}; distance of striæ apart, .45^{mm}.

ORYCTOSCIRTETES nov. gen.

This genus belongs to the group of *Chrysomelidæ*, of which *Haltica* Ill. is the best known representative, the members of which are peculiar

for their swollen hind thighs, enabling them to spring to great distances It appears to belong to the group of *Oedionychites* Chap., in which the last tarsal joint has a more or less prominent bulbous expansion on the hind legs; but it differs from any of the genera described by Chapuis in the nature of this expansion, as well as in other tarsal peculiarities. The basal joint of these hind tarsi is moderately long and cylindrical, scarcely larger at the apical than at the distal extremity; the second and third joints are subequal, the latter slightly the larger, together as long as the basal joint, moderately lobate, the lobes pointed; while the apical joint is nearly *as long as all the other joints combined*, enlarges *gradually* from base to apex, so as to be fully two or three times as large at the apical as at the distal extremity, and bears a pair of exceedingly long and slender, apparently *simple*, very slightly curved claws, nearly *half as long as the apical joint* itself. In other respects it closely resembles the genus *Oedionychis* Latr.

19. *Oryctoscirtetes protogæum.*—A single specimen, pretty well preserved, and exhibiting the dorsal surface, was obtained by the United States Geological Survey of the Territories near Castello's ranch, South Park, Colorado. The head is pretty large, nearly as broad as the prothorax, the eyes moderately large, apparently circular, with large facets, their average diameter being nearly .02^{mm}. The prothorax is broad, with well rounded, somewhat convex sides and front lateral angles, the anterior margin considerably concave; the posterior lateral angles are rectangular, and there is apparently a median furrow on the posterior half, although the appearance may be due to the crushing of the fossil. The surface of the prothorax, and also of the elytra, is very delicately granulate; the elytra are also furnished very indistinctly with several (five or six?) longitudinal ridges, straight and equidistant. The fore femora are swollen as well as the hind pair, but the middle femora cannot be seen. Both middle and hind tarsi are fully four-fifths as long as their tibiæ.

Length, 5^{mm}; breadth, 2.25^{mm}; width of head, 1.25^{mm}; of prothorax, 1.8^{mm}; length of same, .92^{mm}; of elytra, 3^{mm}; of middle tibiæ, 1.34^{mm}; of middle tarsi, 1.12^{mm}; of middle claws, .18^{mm}; of hind femora, 1.32^{mm}; breadth of same, .48^{mm}; length of hind tibiæ, 1.4^{mm}; width of same, .18^{mm}; length of hind tarsi, 1.14^{mm}; of first joint, .32^{mm}; of fourth joint (excl. claws), .48^{mm}; of claws, .22^{mm}; breadth of fourth joint at tip, .1^{mm}.

20. *Trypodendron impressus.*—This species is represented by a single specimen, showing the prothorax and elytra, and was obtained from the Green River Beds in Western Wyoming by Mr. Richardson. It is slightly larger than *T. retusus* (Le C.), but has the prothorax punctured as distinctly as the elytra, and the punctures on the elytra show but a slight tendency to a longitudinal arrangement. The punctures of the prothorax are longitudinally obovate, a very little more frequent than on the elytra, equally distributed throughout; on the elytra they are also equally distributed, but circular, about 0.04^{mm} in diameter, and average .1^{mm} in distance apart: they have but an obscure longitudinal arrangement into nineteen or twenty rows; and the successive punctures of each row are at about the same average distance apart as those of two contiguous rows.

Length of prothorax, 1.28^{mm}; height of same, 1.44^{mm}; length of elytra, 2.8^{mm}; breadth of same, 1.24^{mm}.

21. *Sitones grandævus.*—A single specimen, very poorly preserved, was found by Mr. Richardson on Green River, at the crossing of the Union Pacific Railroad. Little can be seen beside a vague outline of the form of the body, with a broken rostrum; the eye is large, obovate, longitudinally disposed, 0.42^{mm} long, and 0.25^{mm} broad; the elytra are fur-

nished with a number of slight, slender, raised ridges, 0.34^{mm} apart, which are probably the reverses of striæ. In general form, the insect appears to have closely resembled *Eudiagogus examinis* Scudd., but differs from it conspicuously by its longitudinal eye. Dr. Le Conte has suggested to me that it may be an *Anthribide*, near *Cratoparis*.

22. *Otiorhynchus perditus*.—A single specimen, showing a side aspect, was obtained by Mr. Richardson at the same locality as the last. It differs from the species of *Otiorhynchus*, with which I have compared it, in not having the prothorax conspicuously smaller than the body behind it. The head is withdrawn into the prothorax, almost to the hinder edge of the eyes; the snout is short, stout, slightly curved, bluntly rounded and rather tapering than enlarged at the tip, not quite so long (measuring from the front edge of the eyes) as the length of the pronotum; the eyes are rounded, subtriangular, with a diameter equal to half the width of the snout, the central facets with a diameter of 0.027^{mm}; the antennal scrobes are twice as long as broad, commencing at the middle of the snout and extending two-thirds the distance thence to its tip. The prothorax is equal, nearly as long as high, not tumid, rugulose. The elytra, which are not elevated at base above the prothorax, are simple, not very tumid, provided with about eight longitudinal slender rows, .3^{mm} apart, of low, raised, rounded points, nearly as distant from one another as those of contiguous rows; midway between each of these rows is a very inconspicuous dull ridge. Fragments of the legs remain, which agree, as far as they can be made out, with the same parts in *Otiorhynchus*. In the general sculpturing of the elytra this insect is not very unlike *O. sulcatus* (Fabr.)

Length, 8^{mm}; of snout, beyond front of eyes, 1.23^{mm}; width of same, .75^{mm}; length of antennal scrobes, .32^{mm}; diameter of eyes, .46^{mm}; length of pronotum, 1.8^{mm}; height of same, 2.28^{mm}; length of elytra, 5.2^{mm}; width of same, 2.05^{mm}; length of fore femora, 1.8^{mm}.

23. *Entimus primordialis*.—A single specimen, found by Professor Denton, at Chagrin Valley, White River, represents this species. Besides a crushed elytron there are only some indeterminate fragments of the neighboring parts of the body. The form and sculpturing of the elytron resemble those of the Brazilian diamond-beetle so closely that I place the species provisionally in the same genus, or until further remains are obtained. The insect must have been rather small for an *Entimus*, although it is the largest of American Tertiary *Curculionidæ* known to me. It is of about the usual size of the species of *Otiorhynchus*, and it is not at all improbable that it should be referred to the latter genus, some species of which have elytra with similar sculpturing and approximately the same form. The elytron is traversed by ten similar stout and coarse, longitudinal costæ, most of which are broken up by transverse depressions into bead-like hemispherical prominences; at the tip of the elytron, however, and on the apical half of the inner two costæ, this irregularity is nearly or quite lost sight of; the edges of the elytron, for about the width of one of the costæ, is also smooth and depressed; the front border is sinuous, and the sutural margin appears the same on the stone, from the compression the elytron has undergone, which was sufficient to split it down the middle through half its length.

Length of fragment, 8^{mm}; greatest breadth of unsplit portion, 4^{mm}.

24. *Eudiagogus saxatilis*.—Four specimens were obtained by Mr. Richardson beyond the Green River on the Union Pacific Railroad, Wyoming. One of these represents a nearly complete side view of the insect without other appendages than the elytra; another presents a similar appearance, but even the elytra are gone, and the hinder edges of the posterior coxæ are impressed upon the superior surface, giving the appear-

ance of short elytra; a third and fourth specimen are still more fragmentary. The snout is shaped much as in *Otiorhynchus perditus* Scudd., being short, stout, and, especially anteriorly, arched, the front border being faintly angulate about the middle; the antennal scrobes cannot be certainly defined; the eyes are pretty large, transversely ovate, and are, in most of the specimens, indicated on the stone by an annulus of dark color, containing an interior narrow ovate pale spot .22^{mm} long by .12^{mm} wide; while the eye itself is .4^{mm} in its longer and .3^{mm} in its shorter diameter; the facets of the interior portion are very minute, being scarcely .01^{mm} in diameter. The prothorax is somewhat tumid, rather higher than long, very profusely and delicately punctulate, the anterior and posterior walls between the pittings often less elevated than the lateral walls, so that the punctures often form broken longitudinal furrows; the punctures are nearly uniform in size over the whole prothorax and average about .04^{mm} in diameter. The elytra are simple, not tumid, sloping off gradually toward the tip, not elevated at base above the thorax, and provided with six equidistant, very slender and slight, raised ridges, faintly broken into dashes by a series of minute, moderately distant punctures along the inner border of each; these punctures are of the same size as those on the prothorax; the ridges are about .16^{mm} apart. The posterior coxæ have an incrassate posterior margin.

Length of body, 4^{mm}; of rostrum beyond the eye, .68^{mm}; width of same, .46^{mm}; length of prothorax, 1.2^{mm}; height of same, 1.3^{mm}; length of tegmina, 2.8^{mm}; width of same, .9^{mm}.

25. *Eudiagogus examinis.*—A considerable number of specimens of this insect were obtained by Mr. Richardson with the preceding species. All were fragmentary, and most of them rather obscure; they consist mostly of side aspects of the creature, but several are single elytra. The head is rather large at base, tapering, with a short, broad snout, not so deep as broad, equal and at the tip broadly rounded, directed downward and forward, slightly bent along the front margin; the antennal scrobes extend from the front edge of the eye nearly to the end of the rostrum, and are broadest next the eye, where they are half as broad as the eye itself, tapering regularly throughout and shallow; the eyes are moderately large, broadly oval, transverse or a little oblique, the upper extremity thrown backward and the lower forward. The prothorax is short, only about half as long as deep, not tumid, rather cylindrical, its surface smooth. The elytra are not broader nor higher at their base than the surface of the pronotum, and they are simple and furnished with seven equidistant, equally and not deeply impressed, longitudinal striæ, .16^{mm} apart from one another, and the outer ones from the adjacent border; these striæ are provided with slightly longitudinal punctures at regular intervals of about .1^{mm}, by which the striæ are carried to about double their usual depth. Some of the specimens have lost the elytra, and on these the posterior edge of the hind coxæ have been impressed through the abdomen, giving the insects the appearance of being furnished with elytra which cover but half of the abdomen. The same thing was noticed in other species.

Length of body, exclusive of rostrum, 5.75^{mm}; of rostrum beyond the eye, .62^{mm}; breadth of same, .5^{mm}; depth of same, .44^{mm}; length of eye, .36^{mm}; width of same, .24^{mm}; length of prothorax, .72^{mm}; height of same, 1.3^{mm}; length of elytra, 3.05^{mm}; width of same, 1.2^{mm}; length of fore femora, .72^{mm}; width of same, .32^{mm}; length of middle femora, .8^{mm}; width of same, .32^{mm}; length of hind femora, 1.1^{mm}; width of same, .34^{mm}.

26. *Eudiagogus effossus.*—This species is represented by a number of fragments brought by Mr. Richardson from the same place as the pre-

ceding species. They are mostly composed of fragments of elytra, and the only specimens which are preserved entire are such as give a dorsal or ventral aspect. These, however, are enough to show that they belong to a species closely allied to but distinct from the preceding, from which it differs principally in its smaller size, its slenderer and more tapering rostrum, the smaller circular eyes, and in the slightly more distant and rather more deeply impressed striæ of the elytra. The following measurements will give a better understanding of the degree of difference between them in certain points.

Length of body, exclusive of rostrum, 5^{mm}; breadth of same, 2.1^{mm}; width of rostrum at base, $.48^{mm}$; diameter of eyes, $.28^{mm}$; distance apart of the elytral striæ, $.18$–$.20^{mm}$; distance apart of punctures in the striæ, $.11^{mm}$.

27. *Hylobius provectus.*—A single specimen was found by Mr. Richardson with the preceding species. It is very poorly preserved, being not only fragmentary but faintly impressed; the rostrum is broken, so that its length cannot be determined, but the general facies of the insect resembles that of *H. picivorus* Germ. so closely that it must be referred to the same genus. The rostrum is rather stout; the antennal scrobes are slender, and commence not far beyond the eyes; the eyes are very large, transverse obovate, with an interior clear space, as described in *Eudiagogus saxatilis* Scudd., with very small facets, scarcely $.02^{mm}$ in diameter. The thorax is rather small, but apparently partially concealed by the way the specimen is crushed, not very tumid, and entirely smooth. The elytra are of much the same form as those of the species of *Eudiagogus* just described, provided with slender, shallow, impressed lines, about $.22^{mm}$ apart; the latter are rather delicately punctured, the punctures a little less distant from one another than are the rows; the number of rows cannot be determined from this specimen.

Length, exclusive of rostrum, 5^{mm}; length of broken rostrum, $.45^{mm}$; of eyes, $.9^{mm}$; breadth of same, $.44^{mm}$; length of elytra, 4^{mm}.

28. *Anthonomus defossus.*—A single well-preserved specimen, presenting a side aspect, was obtained by Mr. T. L. Mead near Castello's ranch, South Park, Colorado. It is nearly as large as *A. hæmatopus* Boh., with a slightly more curved rostrum, slightly transverse eyes, and with more abundant pitting of the prothorax, which is also less obscured by hairs. The head is smooth, covered very sparsely with very fine, short, almost invisible hairs, directed downward; the antennal scrobes appear to be rather shallow. The prothorax is covered with exactly similar hairs, very distant, apparently arising only on the sharp ridges between the pits with which the surface is completely studded; these pits are rather deep, rounded, about $.032^{mm}$ in diameter, and as closely crowded as possible; the thoracic pleura are similarly pitted, but with a little less frequency, and therefore with coarser bounding walls. The elytra are coarsely ridged with nine equidistant, stout, rounded costæ, $.1^{mm}$ apart, the fourth from the outer border terminating between the conjoined apices of those on either side of it; they are rather more prominent and more distant than in *A. hæmatopus;* the whole surface of the elytra, both costæ and furrows, is dull rugulose. The legs are similar to those of the living species mentioned, but are somewhat shorter.

Length from front of head to tip of elytra, 2.2^{mm}; length of rostrum, $.88^{mm}$; width of same, $.11^{mm}$; length of prothorax, $.54^{mm}$; of middle femora, $.72^{mm}$; breadth of middle femora, $.17^{mm}$; length of eye, $.18^{mm}$; breadth of same, $.14^{mm}$.

29. *Cryptorhynchus annosus.*—A single specimen was found by Mr. Richardson beyond the Green River crossing of the Union Pacific Railroad. The fragmentary specimen is exposed on a side view, with head,

front of prothorax, and all the legs gone, and the elytra a little broken. The prothorax is profusely and uniformly pitted with moderately shallow pits, averaging .06^{mm} in diameter; the elytra are traversed by longitudinal costæ, five of which are much more prominent than the others, with sharp, unbroken edges and equidistant from one another, the outer ones in close proximity to the sutural and outer edges; the other costæ are obscure, slightly elevated, rounded, broken to a greater or less extent into raised points; midway between the first and second prominent costæ (counting from the outer margin) there is an exactly similar prominent costa on the basal third of the elytron; the prominent costæ are .2^{mm} apart.

Length of the prothorax, .88^{mm}; height of same, 1.04^{mm}; length of elytron, 1.96^{mm}; breadth of same, 1.08^{mm}.

30. *Eurhinus occultus.*—Three specimens of this species were found by Mr. Mead, near Castello's ranch, South Park, Colorado. It seems to belong to the *Baridiides* of Lacordaire, and in general appearance more resembles the species of the genus *Eurhinus* than those of any other group known to me; it is, however, smaller than they, and it may have greater affinities with the *Ceutorhynchides.* In any case it seems to be a strictly American type. The first specimen exhibits only the upper surface of the body with a portion of the rostrum. Nothing can be seen of the head excepting the base of the snout, which is slender (perhaps slenderer than usual for *Eurhinus*), with two longitudinal furrows upon the upper surface occupying, together, nearly the whole width of the rostrum. The prothorax is tumid, with sides subparallel close to the posterior extremity, but immediately beyond narrowing rapidly, but with convex outline toward the head; the surface is uniformly and very profusely punctate (granulose on the stone, which is a cast), the punctures averaging .04^{mm} in diameter. The elytra are in place, together not much broader than the prothorax, parted in the apical third, each independently rounded, produced to a blunt tip, and provided with six equidistant, slightly raised slender ridges (as now seen on the stone), .36^{mm} apart, interrupted slightly at regular and short intervals (so that the original doubtless had series of longitudinal stabs).

Length of body, exclusive of rostrum, 6^{mm}; of the visible part of the rostrum, .75^{mm}; breadth of same, .36^{mm}; length of prothorax, 1.4^{mm}; greatest width of same, 3.15^{mm}; length of elytra, 4.3^{mm}; width of same, 1.75^{mm}.

A second specimen is very similarly preserved, and shows the same characteristics. In addition, however, the eyes and some of the legs may be seen. The former are very small, .16^{mm} in diameter, and circular; the legs are rather stout, the femora tumid; the width of the head at the eyes is .8^{mm}.

A third specimen is much more poorly preserved; it is similar to the first, but in relief; more of the rostrum can be seen, and one of the hind femora, which is very stout, being 1.36^{mm} long and .68^{mm} broad.

31. *Brachytarsus pristinus.*—A single specimen was obtained by Mr. Richardson, with the other specimens found by him in Western Wyoming. It is very poorly preserved, and fragmentary. The head is roundish, with small circular eyes .08^{mm} in diameter. The prothorax is subquadrate, considerably larger than the head, and nearly as broad as the body at the base of the elytra; the latter are broken.

Length of fragment, 2.1^{mm}; breadth of same, .84^{mm}; length of head, .39^{mm}; breadth of same, .4^{mm}; of thorax, .64^{mm}.

DEPARTMENT OF THE INTERIOR.

UNITED STATES GEOLOGICAL AND GEOGRAPHICAL SURVEY OF THE TERRITORIES.

F. V. HAYDEN, U. S. GEOLOGIST-IN-CHARGE.

I.—STUDIES OF THE AMERICAN FALCONIDÆ.

BY ROBERT RIDGWAY.

II.—ORNITHOLOGY OF GUADELOUPE ISLAND.

BY ROBERT RIDGWAY.

No. 2——1

STUDIES OF THE AMERICAN FALCONIDÆ.

By Robert Ridgway.

Genus NISUS, Cuvier.

INTRODUCTION.

The latest authority on the birds of the family to which the genus *Nisus* belongs (the "Catalogue of the Accipitres, or Diurnal Birds of Prey, in the Collection of the British Museum", by Mr. R. Bowdler Sharpe*) allows eleven American species which we consider as belonging to this genus as properly restricted, they being included in that work in the genus "*Accipiter*." The species recognized by Mr. Sharpe are the following:—

(1.) "2. Accipiter fuscus." (p. 135.)
(2.) "3. Accipiter cooperi." (p. 137.)
(3.) "4. Accipiter tinus." (p. 139.)
(4.) "8. Accipiter collaris." (p. 144.)
(5.) "13. Accipiter erythrocnemis." (p. 147.)
(6.) "14. Accipiter chionogaster." (p. 148.)
(7.) "16. Accipiter ventralis." (p. 149.)
(8.) "19. Accipiter guttatus." (p. 152.)
(9.) "20. Accipiter pileatus." (p. 153.)
(10.) "21. Accipiter bicolor." (p. 154.)
(11.) "22. Accipiter chilensis." (p. 155.)

Besides the above, two species which are probably closely allied to this group, are given, but it seems to us erroneously, under the genus *Astur*, these being the *Falco poliogaster* of Temminck and the *Astur pectoralis* of Bonaparte. These two remarkable and rare species we have had no opportunity to examine, in order to verify the propriety of including them in the genus *Astur*, but the probability is very strong that they will prove subgenerically, if not generically, distinct from the typical members of that genus.

To aid us in the study of this difficult group, we have had access to the collections of the principal museums of the United States; the National museum, at Washington, the collection of the Philadelphia Academy of Natural Sciences, the American Museum at Central Park in New York City, the museum of the Boston Society of Natural History, and the Museum of Comparative Zoölogy at Cambridge, Mass., furnishing the bulk of the material. Two species not known to exist in any American museum were furnished for examination by Mr. Osbert Salvin, of England, who kindly loaned his large and elegant series of these birds for the purpose; the unique type of another was obtained from the museum of Vassar College, Poughkeepsie, N. Y., through the courtesy of Professor James Orton, its collector; and Mr. George N. Lawrence, of

* London, 1874, 8 vo., pp. 479, pls. xiv.

New York, forwarded his large and remarkably fine collection for study in this connection. Altogether, we have been enabled to examine and compare upward of four hundred specimens, including thirteen species, as follows:—

List of species and specimens examined.

	U. S. Nat. Mus.	Mus. Phila. Acad.	Amer. Mus. N. Y.	Mus. Boston Soc.	Mus. Comp. Zool.	Mus. G. N. Lawrence.	Mus. O. Salvin.	Mus. Vassar College.	Mus. S. F. Baird.	Mus. R. Ridgway.	Other collections.	Total.
1. Nisus cooperi	75	18	3	4	3	9	.....	.....	6	7	3	128
2. Nisus gundlachi	2	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2
3. Nisus bicolor	8	5	1	2	.....	5	.....	.....	.....	.....	.....	21
4. Nisus pileatus	5	.....	.....	7	1	.....	.....	.....	.....	.....	.....	13
5. Nisus chilensis	3	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	3
6. Nisus chionogaster	.....	.....	.....	.....	.....	.....	7	.....	.....	.....	.....	7
7. Nisus salvini	.....	.....	.....	.....	.....	.....	2	.....	.....	.....	.....	2
8. Nisus ventralis	2	6	.....	.....	.....	2	8	.....	.....	.....	.....	18
9. Nisus nigroplumbeus	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	1
10. Nisus erythrocnemis	3	3	1	.....	.....	1	3	.....	.....	.....	.....	11
11. Nisus fuscus	120	14	7	5	9	1	12	.....	2	8	4	182
12. Nisus tinus	.....	3	3	2	.....	2	7	.....	.....	1	.....	18
13. Nisus collaris	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	1
Total	218	50	15	20	13	20	39	1	8	16	7	407

Of the above-named species, three are not included by Mr. Sharpe: *N. gundlachi*, being mentioned in a foot-note, and doubtfully referred to *N. cooperi; N. nigroplumbeus*, is referred to *N. ventralis*, while *N. salvini* is new, and first named here. On the other hand, there are two species of this genus which we have not seen, viz, *N. guttatus* and *N. fringilloides*, both of which appear to be perfectly distinct.

Subgenera.

Regarding subgeneric divisions of the above group of species, several have been proposed and named, but we are unable to make out more than two which are capable of definition; these two groups constitute quite distinct subgenera, and may be characterized as follows:—

NISUS.—Five outer primaries, with inner webs emarginated; fourth or fifth quills longest; inner toe not reaching middle of second joint of middle toe.

HIERASPIZIAS.—Four outer primaries, with inner webs emarginated; hird or fourth quills longest; inner toe reaching to or beyond middle f second joint of middle toe.

SUBGENUS NISUS, CUVIER.

Accipiter BRISSON, Orn. i, 1760, 10.—Type, *Falco nisus* Linn. (= *N. fringillarius*).
Nisus CUVIER, Leçons Anat. Comp. i, tabl. ois. 1799.—Same type.
Ierax LEACH, Syst. Cat. Mam. etc. Brit. Mus. 1816, 10.—Same type.
Cooperastur BONAPARTE, Rev. et Mag. de Zool. 1854, 538.—Type, *Falco stanleyi* Aud. (= *N. cooperi*).
Leptohierax SUNDEVALL, Disp. Acc. Hemeroharp, 1872, 24.—Same type.

CHARACTERS.—Five outer primaries with inner webs emarginated; fourth or fifth quills longest; inner toe reaching scarcely beyond the first joint of the middle toe, or falling short of it.

Notwithstanding the wide difference in size between the larger and smaller species of this subgenus, it is absolutely impossible to make a further subdivision of the group, since no characters exist upon which to found such a distinction. Indeed, each *species* presents greater variations of size and proportions dependent on sex than exist between the majority of the species. For example, in *N. cooperi*, one of the larger species, the maximum measurements are:—Wing, 11.00; tail, 10.50; culmen, 0.80; tarsus, 2.85; and middle toe, 1.85; while in *N. fuscus*, one of the smaller species, the minimum is:—Wing, 6.35; tail, 5.50; culmen, 0.35; tarsus, 1.85; middle toe, 1.10, an average difference of nearly one-half in dimensions between the female of *cooperi* and the male of *fuscus;* but reversing the sexes, we have, as the minimum measurements of *cooperi:*—Wing, 8.70; tail, 7.80; culmen, 0.58; tarsus, 2.30; middle toe, 1.45; and as the maximum of *fuscus:*—Wing, 8.80; tail, 8.20; culmen, 0.60; tarsus, 2.30; middle toe, 1.55—the conspicuous difference being thus completely lost. As regards proportions of the toes, the male of *cooperi* and the female of *fuscus* (typical representatives of the two extremes of size) have the inner toe reaching to a little beyond the first joint of the middle toe; but, in the male of *fuscus*, it falls considerably short of the first articulation. The latter has usually the scutellæ fused into a continuous plate; but the female, particularly in the immature stage, has the scutellæ very distinctly defined. The latter condition is almost universal in *cooperi;* but an adult male in our collection (No. 2554) has as completely "booted" a tarsus as any example of *fuscus* we have seen.

The sexual differences in plumage are inconsiderable, or, practically, inappreciable; but the young and old are entirely different in colors and markings, there being usually no resemblance whatever, except in the tail, which is much the same at all ages in each species. It is this fact, and the lack of any other available character to answer the purpose, that has induced us to attach so much importance to the tail-bands in our key to the species.

The following table of measurements will serve to show the comparative size of the species as well as the limits of variation in each. A wider range would doubtless be shown in several of these had we a larger series for measurement, there being in the annexed table one or two instances where but one sex is represented.

Comparative measurements of American species of NISUS.

	Wing.	Tail.	Culmen.	Tarsus.	Middle toe.
1. Nisus cooperi	8. 70–11. 00	7. 80–10. 50	0. 58–0. 80	2 30–2. 85	1. 45–1. 85
2. Nisus chilensis	8. 25– 9. 90	7. 65– 8. 50	0. 50–0. 70	2. 25–2. 65	1. 40–1. 70
3. Nisus guttatus	8. 50–10. 50	6. 80– 8. 50	0. 60	2. 40–2. 65	.....
4. Nisus gundlachi	8. 60–10. 50	7. 50– 9. 50	0. 68	2. 50–2. 75	.....
5. Nisus pileatus	8. 10–10. 40	6. 80– 9. 00	0. 50–0. 70	2. 20–2. 65	1. 35–1. 70
6. Nisus bicolor	8. 00–10. 00	7. 20– 8. 80	0. 55–0. 75	2. 25–2. 70	1. 45–1. 80
7. Nisus chionogaster	6. 80– 8. 40	6. 00– 7. 30	0. 40–0. 52	1. 90–2. 25	1. 30–1. 55
8. Nisus ventralis	6. 30– 8. 70	5. 40– 7. 25	0. 35–0. 55	1. 65–2. 20	1. 10–1. 50
9. Nisus erythrocnemis	6. 25– 8. 00	5. 40– 6. 20	0. 35–0. 45	1. 55–2. 00	1. 10–1. 40
10. Nisus nigroplumbeus	6. 75	6. 30	0. 45	1. 95	1. 30
11. Nisus fuscus	6. 35– 8. 80	5. 50– 8. 20	0. 35–0. 60	1. 85–2. 30	1. 10–1. 55
12. Nisus salvini	7. 60– 7. 80	6. 90– 7. 00	0. 50	2. 15–2. 20	1. 45–1. 50
13. Nisus fringilloides	6. 25	4. 80	.....	1. 80	.....

The following key to the species is the best we have been able to devise from very complicated and variable characters presented. The characters common to all the species are the following:—

COMMON CHARACTERS.—Tail crossed by wide bands of blackish and

grayish, three to six in number, the last black band broadest and usually subterminal; tail sometimes (in fresh plumages) with a terminal margin of white. *Adult:*—Above, uniform slate or plumbeous, growing darker on the pileum, which is sometimes black; occipital feathers pure white beneath the surface, and scapulars with large concealed spots of the same. Legs and feet yellow; lower parts extremely variable, usually with transverse markings of rufous or brown, rarely white, broken only by dusky shaft-streaks or narrow faint stripes on the breast and sides, and uniform rufous tibiæ; sometimes entirely rufous, or uniform plumbeous, with rufous on the tibiæ. *Young:*—Above, dark brown, the feathers with terminal margins of rusty brown or buff. Beneath, white or ochraceous, usually with longitudinal (rarely with transverse) markings of brown—immaculate only in *N. bicolor.*

Key to the species.

A.—Black bands of the tail decidedly narrower than the gray interspaces.

a. Size large (wing, 8.25–11.00; tail, 6.80–10.50).

1. N. COOPERI.—Wing, 8.70–11.00; tail, 7.80–10.50; culmen, 0.58–0.80; tarsus, 2.30–2.85; middle toe, 1.45–1.85. Tail with four black bands. *Adult:*—Beneath, white, with transverse spots or bars of rufous, except on throat and crissum. *Young:*—Thighs variously marked with brown; breast, belly, and sides with stripes of the same. *Hab.*—North America, except Arctic region and West Indies.

2. N. GUTTATUS.—Wing, 8.50–10.50; tail, 6.80–8.50; culmen, 0.60; tarsus, 2.40–2.65. Tail with four black bands. *Adult:*—Beneath, pale "fawn-rufous"; the breast with white spots and half-bars; the thighs and lining of wing plain. *Hab.*—Paraguay and Bolivia.

3. N. CHILENSIS.—Wing, 8.25–9.90; tail, 7.65–8.50; culmen, 0.50–0.70; tarsus, 2.25–2.65; middle toe, 1.40–1.70. Tail with five to six black bands. *Adult:*—Tibiæ plain rich rufous; other lower parts, except crissum, ash-gray or umber, shaded with rufous and slate-color, and broken by white spots, these forming distinct bars on the abdomen. *Young:*—Below, buff, more rusty on the tibiæ, the latter transversely spotted with rusty-brown; breast, sides, and abdomen with lanceolate or ovate stripes of blackish. *Hab.*—Chile to Straits of Magellan.

4. N. GUNDLACHI.—Wing, 8.60–10.50; tail, 7.50–9.50; culmen, 0.68–0.70; tarsus, 2.50–2.75. Tail with four black bands. *Adult:*—Jugulum and sides of neck plain ash-gray; lower part of breast and upper portion of abdomen plain rufous, the feathers narrowly margined with white; tibiæ rufous, the feathers with subterminal darker bars and lighter tips. *Young:*—Sides and tibiæ with broad transverse spots of brown; breast and abdomen with broad stripes of the same; longer lower tail-coverts with narrow shaft-stripes of blackish. *Hab.*—Cuba.

b. Size small (wing, 6.35–8.80; tail, 5.50–8.25).

5. N. FUSCUS.—Wing, 6.35–8.80; tail, 5.50–8.25; culmen, 0.35–0.60; tarsus, 1.85–2.30; middle toe, 1.10–1.55. Tail with four to five black bands. *Adult:*—Tibiæ barred or spotted transversely with rufous and white; other lower parts, except throat and crissum, with wide bars or transverse spots of rufous and white. *Young:*—Tibiæ white or pale rusty, with markings of brown of variable shape; other lower parts, except crissum, with brown stripes, more spot-like on the sides. *Hab.*—Entire continent of North America. (Not in West Indies.)

6. N. FRINGILLOIDES.—Wing, 6.25–?; tail, 7.80–?; tarsus, 1.80–?; middle toe, ?. Tail with five black bands (*qu.:* narrower than gray ones ?). *Adult:*—Lower parts white, the auriculars and sides of neck uniform light rufous; breast, abdomen, sides, and tibiæ with narrow bars of pale rufous or brown, faintest on the tibiæ. *Young:*—Tibiæ and abdomen with bars or transverse waved lines of brown; breast with irregular spots of the same. *Hab.*—Cuba.

B. Black and gray bands of the tail about equal in width. (Size small.)

7. N. ERYTHROCNEMIS.—Wing, 6.25–8.00; tail, 5.40–6.20; culmen, 0.35–0.40; tarsus, 1.55–2.00; middle toe, 1.10–1.40. Tail with four to five blackish bands. *Adult:*—Auriculars, sides of neck, and sides (under wings) light rufous; tibiæ uniform deep rufous; breast and abdomen with narrow bars of pale brown or rufous. *Young:*—Tibiæ uniform deep rufous; sides tinged with the same; breast and sides with sagittate spots of rusty brown. *Hab.*—Eastern South America.

8. N. CHIONOGASTER.—Wing, 6.80–8.40; tail, 6.00–7.30; culmen, 0.40–0.52; tarsus, 1.90–2.25; middle toe, 1.30–1.55. Tail with four to five blackish bands. Lower parts white without distinct markings; tibiæ uniform ochraceous or buff. *Adult:*—White of lower parts relieved only by fine black shaft-streaks on breast and throat. *Young:*—Breast and sides with faint stripes of dilute brown. *Hab.*—Guatemala.

C.—Black bands of the tail decidedly wider than the gray ones.

a. Size small (wing, 6.30–8.60; tail, 5.40–7.25).

9. N. SALVINI.—Wing, (♀?) 7.60–7.80; tail, 6.90–7.00; culmen, 0.50; tarsus, 2.15–2.40; middle toe, 1.45–1.50. Tail with four to six gray bands. Lower parts white, without distinct markings; tibiæ uniform deep rufous. *Adult:*—Feathers of the breast and sides with dusky shaft-streaks. *Young:*—Breast and sides with narrow stripes of dilute brown. *Hab.*—Venezuela.

10. N. VENTRALIS.—Wing, 6.30–8.70; tail, 5.40–7.25; culmen, 0.35–0.55; tarsus, 1.65–2.20; middle toe, 1.10–1.50. Tail with four gray bands. Tibiæ uniform rufous. *Adult:*—Lower parts mostly rufous, the crissum usually whitish; middle of breast and abdomen sometimes showing faint bars of whitish. Occasionally entirely rufous underneath. *Young:*—Breast, sides, and abdomen with broad sagittate spots of brown. *Hab.*—Columbia.

11. N. NIGROPLUMBEUS.—Wing, 6.75; tail, 6.30; culmen, 0.45; tarsus, 1.95; middle toe, 1.30. Tail with four gray bands. *Adult:*—Lower parts plumbeous, mixed with rufous on crissum, abdomen, tibiæ, and lining of wing. *Hab.*—Quito Valley, Ecuador.

b. Size large (wing, 8.00–10.40; tail, 6.80–9.00).

12. N. BICOLOR.—Wing, 8.00–10.00; tail, 7.20–8.80; culmen, 0.50–0.75; tarsus, 2.25–2.70; middle toe, 1.45–1.80. Tail with three to five gray bands. No markings on lower parts. *Adult:*—Beneath, pearl-gray; tibiæ rufous; crissum and lining of wing whitish. *Young:*—Lower parts uniform white or ochraceous; a distinct nuchal collar of the same. *Hab.*—Central America, from Costa Rica to Columbia.

13. N. PILEATUS.—Wing, 8.10–10.40; tail, 6.80–9.00; culmen, 0.50–0.70; tarsus, 2.20–2.65; middle toe, 1.35–1.70. Tail with four

to five gray bands *Adult:*—Beneath, pearl-gray; tibiæ and lining of wing rufous; crissum whitish: *Young.*—Beneath, white or ochraceous, with lanceolate or ovate stripes of brownish-black on breast and sides. Upper parts much variegated by white spotting; no distinct nuchal collar. *Hab.*—Eastern South America.

Certain single characters, or peculiar combinations of conspicuous characters, serve for the easy identification of the species; the following being the more prominent ones:—

A. Tibiæ uniform rufous.
  a. Size large.
    * Breast and belly plain pearl-gray.
      1. Lining of wing whitish.....*bicolor*, adult.
      2. Lining of wing rufous.....*pileatus*, adult.
    ** Breast and belly spotted with white.
      1. Ground-color of breast pale fawn-rufous..... *guttatus*, adult.
      2. Ground-color of breast slaty or umber.....*chilensis*, adult.
  b. Size small.
    * Breast white, faintly streaked or striped....*salvini*, ad and yng.
    ** Breast white, with broad sagittate spots of brown.
      1. Black bands on tail and gray interspaces equal in width, *erythrocnemis*, young.
      2. Black bands on tail decidedly wider than gray interspaces, colors all darker.....*ventralis*, young.
    * Breast white, with narrow transverse bars ..*erythrocnemis*, adult.
    ** Breast plain rufous, or with faint whitish bars in middle portion..... *ventralis*, adult.
    * Breast plain plumbeous.....*nigroplumbeus*, adult.

B. Tibiæ mixed white and rufous.
  a. Size large.
    * Breast plain gray.....*gundlachi*, adult.
    ** Breast spotted rufous and white.....*cooperi*, adult.
  b. Size small.
    * Cheeks rusty-white, with dusky streaks; tibiæ with broad rufous spots.....*fuscus*, adult.
    ** Cheeks plain rufous, without streaks; tibiæ with narrow bars of rufous.....*fringilloides*, adult.

C. Tibiæ white, with narrow bars of brown.....*fringilloides*, young.

D. Tibiæ plain buff or ochraceous; breast pure white, with dusky shaft-streaks; size small.....*chionogaster*, adult and young.

E. Tibiæ white or rusty, with spots or streaks of brown.
  a. Breast thickly striped with deep sepia-brown, the sides with broad bars of the same.
    * Size large..... ....*gundlachi*, young.
    ** Size small.....*fuscus*, young.
  b. Breast with narrow stripes of paler brown; the sides also striped.
    * Size large.....*cooperi*, young.
    ** Size small.....*fuscus*, young.
  c. Sides of breast with lanceolate or ovate stripes of blackish.
    * Above much varigated with whitish spotting....*pileatus*, young.
    ** Above without exposed white spotting.....*chilensis*, young.

F. Lower parts immaculate white or ochraceous; a distinct nuchal collar of the same.....*bicolor*, young.

NISUS COOPERI.

Northern Falcon LATH. Gen. Synop. i, 1781, 79, No. 62 (= ♀ ad.).
Falco hyemalis β. GMEL. S. N. i, 1788, 274 (= ♀ ad.).
Falco cooperi BONAP. Am. Orn. i, 1828, pl. 10, fig. 1; Ann. Lyc. N. Y. ii, 433; Isis, 1832, 1137.—JAMESON (ed. Wils.), Am. Orn. iv, 1831, 3.—BREWER, Bost. Journ. N. H. i, 1837, 436 (Mass.).—PEABODY, *ib.* iii, 1841, 78.—THOMPSON, Nat. Hist. Vermont, 1853, p. —.—READ, Pr. Ac. Nat. Sci. Phila. 1853, p. — (N. Ohio).
Astur cooperi BONAP. Comp. List, i, 1838, 5; Rev. Zool. 1850, 489; Consp. Av. i, 1850, 31.—JARDINE (ed. Wilson), Orn. 1840, 651.—GAMBEL, Pr. Ac. Nat. Sci. Phila. 1846, p. — (California).—PRATTEN, Tr. Ill. Ag. Soc. 1853-4, 599 (S. Illinois).—KENNICOTT, *ib.* 581, (N. Ill.).—PUTNAM, Pr. Essex Inst. 1856, 204 (Mass.).
Accipiter cooperi DE KAY, Zoöl. N. Y. ii, 1844, 18, pl. iv, fig. 5.—GRAY, List. Acc. Brit. Mus. 1848, 38; Genera of B. i, 1849, 29; Hand List, i, 1869, 32.—CASSIN, Pr. Ac. Nat. Sci. 1848, p. — (Xalapa); *ib.* 1855, 279; Ill. Birds Cal. Tex. etc. 1856, 96; Birds N. Am. 1858, 16.—HOY, Pr. Ac. Nat. Sci. Phila. 1853, p. — (Wisconsin); Smithsonian Rep. 1864, 437 (Missouri).—KNEELAND, Pr. Boston Soc. N. H. 1857, 233 (Keweenaw Point, Lake Superior).—HEERMANN, Pacific R. R. Rep. vii, 1857, 31.—NEWBERRY, *ib.* vi, iv, 1857, 74.—BREWER, N. Am. Oölogy, 1857, 20, pl. v, fig. 55.—.—MAX. Caban, Journ. vi, 1858, 13.—BAIRD, Cat. N. Am. Birds, 1859, No. 15.—HENRY, Pr. Ac. Nat. Sci. Phila. 1859, p. —.—SCLATER, P. Z. S. 1859, 389.—BARNARD, Smithsonian Report, 1860, 434 (Pennsylvania).—COOPER & SUCKLEY, P. R. R. Rep. xii, ii, 1860, 145.—BLAKISTON, Ibis, 1861, 317 (Forks of the Saskatchewan, May 21).—BOARDMAN, Pr. Boston Soc. N. H. 1862, 122 (Calais, Maine, summer).—VERRILL, Pr. Essex Inst. iii, 1863, p. — (Maine).—SAMUELS, Rep. Sec. Agr. Mass. 1864, p. —; Birds New Eng. 1870, 27.—DRESSER, Ibis, 1865, 323 (Texas).—COUES, Pr. Ac. Nat. Sci. Phila. 1866, 43 (Arizona); Pr. Essex Inst. 1868, p. —; Pr. Boston Soc. 1868, 120 (S. Carolina); Pr. Ac. Nat. Sci. Phila. 1871, 27 (Ft. Macon, N. C.); Key to N. Am. Birds, 1872, 212; Check-list N. Am. Birds, 1873, 67; Birds Northwest, 1874, 334.—LAWR. Ann. Lyc. N. Y. 1866, p. —; 1868, 134 (Costa Rica).—ALLEN, Am. Nat. 1870, 173 (migrations); Bull M. C. Z. 1871, p. — (Florida).—SCL. & SALV. Ex. Orn. xi, 1869, 170; Nom. Neotr. 1873, 129.—TURNBULL, Birds of E. Penn. 1869, p. —.—RIDGWAY, Pr. Ac. Nat. Sci. Phila. 1870, 141.—MAYNARD, Birds of Mass. 1870, 163.—ROSS, Birds of Canada, 1871, 3.—MAYNARD, Pr. Boston Soc. Nat. Hist. 1871, 26.—SNOW, Birds of Kansas, 1872, 2.—ADAMS, Rambles, 1873, 297.—LAWR. Mem. Boston Soc. N. H. 1874 (S. W. Mexico in Winter; biographical notes by A. J. Grayson).—HENSHAW, Ann. Lyc. N. Y. 1874, 10 (Utah).—SHARPE, Cat. Acc. Brit. Mus. 1874, 137.—HATCH, Bull. Minn. Acad. Sciences, 1874, 51 (Minnesota).
Nisus cooperi SCHLEG. Rev. Acc. 1873, 73.—RIDGWAY, Pr. Boston Soc. N. H. 1873, 59; *ib.* 1874, p. 23 (S. Ill.); Bull. Essex Inst. 1873, 167; *ib.* 1875, 10, 13, 19, 21, 34, 38; in B. B. &. R. Hist. N. Am. B. iii, 1874, 230; Ann. Lyc. N. Y. 1874, 181 (Illinois).—HENSHAW, Rep. Orn. Specs. Wheeler's Exp. 1874, 49. 138.
Falco stanleyi AUDUBON, Birds Am. 1831, pls. 36, 141; Orn. Biog. i, 1831, 186.
Cooperastur stanleyi BONAP. Rev. et Mag. Zool. 1854, 538.
Accipiter mexicanus SWAINSON, Fauna Bor.-Am. ii, 1831, 45.—JARDINE (ed. Wilson), Am. Orn. ii, 1832, 215.—BONAP. Consp. Av. i, 1850, 32 (sub *A. fuscus*).—STRICKL. Orn. Syn. i, 1855, 109.—CASSIN, Illust. Birds Cal. Tex. etc. 1856, 96; Pr. Ac. Nat. Sci. Phila. 1855, 279; Birds N. Am. 1858, 17.—XANTUS, Pr. Ac. Nat. Sci. Phila. 1859, 190 (S. California).—HENRY, *ib.* p. — (New Mexico).—COOPER & SUCKLEY, Pacific R. R. Rep. xii, ii, 1860, 146 (Washington Ter.).—COUES, Ibis, 1865, p. —; *ib.* 1866, p. —; Pr. Ac. Nat. Sci. 1866, 43 (Arizona).—COOPER, Am. Nat. 1868 (Montana); Orn. Cal. i, 1870, 465.—GRAY, Hand List, i, 1869, 33.
Nisus cooperi var. *mexicanus* RIDGWAY, Pr. Boston Soc. 1873, 59; Bull. Essex Inst. 1873, 168 (Colorado); in B. B. &. R. Hist. N. Am. Birds, iii, 1874, 231.
Accipiter pileatus STRICKLAND, Orn. Syn. i, 1855, 105 (in part; not *A. pileatus* Vigors).

Habitat.—United States and table-lands of Mexico; southward (in winter) to Costa Rica and Veragua; north (in summer) to New Brunswick, the Saskatchewan, and Washington Territory.

Diagnosis.—Wing, 8.70–11.00; tail, 7.80–10.50; culmen, 0.58–0.80; tarsus, 2.30–2.85; middle toe, 1.45–1.85. Fourth or fifth quill longest; first equal to or shorter than tenth; outer five with inner webs sinuated. Tail rounded. Tarsi usually distinctly scutellate.

Adult.—Above slate-color, varying from a fine bluish to a brownish

cast, the shafts of the feathers black. Pileum plumbeous-black, the occipital feathers snow-white beneath the surface; primaries plain brownish-slate, their shafts clear brown. Tail narrowly tipped with white, and crossed by four very regular, but sometimes not sharply-defined, bands of dusky, narrower than the slaty ones, the last broadest, the first nearly obsolete, and concealed by the coverts, which are sometimes narrowly tipped with white. Lower parts white and rufous, in transverse bars, the shafts of the feathers black, and the rufous bars usually connected along the middle portion of the feathers; tibiæ more deeply colored, the rufous usually predominating; crissum immaculate white. Lining of the wing white, irregularly spotted with deep rufous; inner webs of the primaries with transverse bands of dusky and white anterior to their emargination and silvery-gray terminally, the dusky bands about seven in number on the longest quill, the two colors nearly equal in width. *Male:*—Slate of the upper parts of a fine bluish cast; nape and sides of the head bluish-ashy, the sides of the breast usually tinged with the same. Wing, 8.85–9.40; tail, 7.80–8.30; culmen, 0.60–0.68; tarsus, 2.30–2.60; middle toe, 1.45–1.55. (Eight specimens.) *Female:*—Slate of the upper parts of a brownish cast; nape and sides of the head dull rusty-rufous, the sides of the breast without ashy tinge. Wing, 10.10–10.80; tail, 9.00–9.40; culmen, 0.70–0.80; tarsus, 2.65–2.85; middle toe, 1.60–1.85. (Five specimens.)

[*Colors in life:*—Terminal half of bill deep black, basal half pale blue; cere greenish-yellow; iris deep orange-red; tarsi and toes deep lemon-yellow.]

Young:—Above, grayish-brown, the feathers more or less bordered with rusty; the scapulars and upper tail-coverts with concealed white spots; the occiput blackish, with the bases of the feathers white, and the pileum and nape streaked with rusty. Tail grayish-brown, tipped with whitish, and crossed by four bands of brownish-black or dusky. Lower parts white, longitudinally striped with clear dusky brown; the shafts black.

[*Colors in life:*—Iris varying from greenish-white to chrome-yellow; bill blackish terminally, pale blue basally; tarsi and toes varying from very pale greenish-yellow to lemon-yellow; claws slate-black.]

Variations.—The extent of individual variation in this species, though very considerable, is limited by the terms of the above diagnosis. Adult males vary as follows:—

No. 10,086, Washington, D. C. (type of description of *N. cooperi, adult male*, in Baird, Brewer, and Ridgway's History North American Birds, vol. iii, p. 230):—Forehead, crown, and occiput blackish-plumbeous, the latter snowy-white beneath the surface; rest of upper parts slaty-plumbeous, the nape abruptly lighter than the occiput; feathers of the nape, back, scapulars, and rump with darker shaft-lines; scapulars with concealed cordate and circular spots of white; upper tail-coverts sharply tipped with white. Tail more brownish than the rump, sharply tipped with pure white, and crossed with three broad, sharply-defined bands of black, the first of which is concealed, the last much broadest; that portion of the shaft between the two exposed black bands white. Lores grayish; cheeks and throat white, with fine, hair-like shaft-streaks of blackish; ear-coverts and sides of neck more ashy and more faintly streaked. Ground-color beneath pure white, but broken by detached transverse bars of rich vinaceous-rufous, on the jugulum, breast, sides, flanks, abdomen, and tibiæ; the white bars everywhere (except on sides of the breast) rather exceeding the rufous in width; all the feathers (except tibial plumes) with distinct black shaft-lines;

lower tail-coverts immaculate pure white. Lining of the wing white, with numerous cordate spots of rufous; under wing-coverts with transverse blackish bars; under side of primaries silvery-white, purest basally (tips dusky), crossed with quadrate bars of dusky, of which there are six (the first only indicated) upon the longest quill (fourth). Wing, 9.35; tail, 8.30; culmen, 0.68; tarsus, 2.45; middle toe, 1.55. Fourth quill longest; third shorter than fifth; second intermediate between sixth and seventh; first, 2.80 shorter than longest; graduation of tail, 1.00.

No. 12,024, Fort Tejon, Cal.; J. Xantus (type of description of var. *mexicanus*, *adult male*, in History North American Birds, iii, p. 231):—Forehead, crown, and occiput plumbeous-black, feathers of the latter with basal two-thirds snowy-white. Upper plumage deep plumbeous, darkest anteriorly, the back being scarcely lighter than the nape; rump fine bluish-plumbeous. No concealed white on the upper parts. Tail brownish-plumbeous, narrowly tipped with pure white, and with four sharply-defined broad bands of black, the first of which is faintest, and concealed by the coverts, the last broadest; shafts of tail-feathers deep brown throughout. Primaries and secondaries much darker than the tail, and more bluish; less so, however, than the scapulars. Lores whitish, quite in contrast with the black of the forehead; cheeks and ear-coverts dark ashy, slightly washed with reddish, and with obscure darker streaks; chin and throat white, with sparse, hair-like shaft-streaks of black. Breast, abdomen, sides, flanks, and tibiæ fine vinaceous-rufous, the feathers (except on tibiæ) with fine hair-like shaft-streaks of black; breast, abdomen, sides, and flanks with pairs of transverse elliptical white spots, not touching the shaft; on the abdomen, the white and rufous bars are of about equal width; on the tibiæ, the rufous is deepest, and exceeds the white in amount; anal region barred with rufous, more faintly than the abdomen; lower tail-coverts immaculate snowy-white. Sides of the neck deep reddish-ashy, this washing the whole side of the breast. Lining of the wing reddish-white, with numerous crowded, cordate, somewhat blended spots of rufous; larger coverts transversely spotted with blackish; under side of primaries silvery-white (blackish for about the terminal inch), crossed with quadrate spots of blackish, of which there are about seven on the longest quill (fourth); the basal ones are, however, so much broken that the number is rather indefinite. Wing, 9.10; tail, 8.20; culmen, 0.65; tarsus, 2.60; middle toe, 1.50.

No. 66,237, Westfield, Mass., October 10, 1846:—Very similar to the preceding (No. 12,024), but even darker, the rufous of the lower parts deeper, and the ashy tinge on the side of the breast still stronger. Wing, 9.20; tail, 8.15; culmen, 0.65; tarsus, 2.55; middle toe, 1.50.

No. 6,874, Sacramento Valley, California, differs from the two preceding in having the entire breast barred with rufous and white, instead of having the sides ashy, the white bars restricted to the middle portion; the black of the pileum terminates abruptly on the occiput, and the sides of the neck are tinged with rusty, as in females. Wing, 9.30; tail, 8.15; culmen, 0.60; tarsus, 2.45; middle toe, 1.50. It resembles No. 10,086, except that the colors are uniformly of a darker shade throughout.

No. 2,554 (Mus. R. R.), Washington, D. C., differs from No. 10,086, in paler colors and more delicate shades; the sides of the breast have a distinct wash of pearly-ash, while the nape is pale bluish-ash, lighter than the back, and abruptly defined against the dark-plumbeous crown. Wing, 9.40; tail, 8.30; culmen, 0.65; tarsus, 2.50; middle toe, 1.55.

No. 42,074, Mirador, Mexico, is extremely similar to the last, but lacks the ashy tinge on the side of the breast. Wing, 8.85; tail, 7.80; culmen, 0.65; tarsus, 2.40; middle toe, 1.45. Another Mirador specimen (No. 23,809) is exactly similar; it measures: wing, 9.40; tail, 8.10; tarsus, 2.30; middle toe, 1.45—nearly the same as the Washington specimen.

No. 5,841, Puget Sound, October 4, is exactly similar to No. 6,874 (Sacramento Valley), and has, like it, the forehead strongly tinged with dull rusty. Wing, 8.90; tail, 8.00; culmen, 0.62; tarsus, 2.45; middle toe, 1.55.

The adult females differ pretty constantly from the males in the much browner upper parts and rusty instead of ashy nape and auriculars, though this last feature is a less constant distinction.

No. 26,588, Washington, D. C.:—Similar to the male, but the upper parts lacking entirely any bluish cast, and the rufous of the lower parts less vinaceous in tint. Forehead tinged with rusty-brown; neck and auriculars uniform dull rufous, with a rusty-brown tinge, and sides of the breast entirely destitute of ashy wash. Wing, 10.80; tail, 9.00; culmen, 0.75; tarsus, 2.65; middle toe, 1.85; fourth and fifth quills equal and longest; third longer than sixth; second intermediate between sixth and seventh; first three inches shorter than the longest.

No. 57,867, Tehuantepec, Southern Mexico (January 8, 1869), is exactly like No. 26,588, except that the tibiæ are deeper and nearly uniform rufous. Wing, 10.35; tail, 9.40; culmen, 0.70; tarsus, 2.80; middle toe, 1.70.

No. 55,018, Mazatlan, Western Mexico (February 21), differs in having the rufous bars of the lower parts browner, more sharply defined, and more regularly transverse. Wing, 10.10; tail, 9.30; culmen, 0.75; tarsus, 2.65; middle toe, 1.60.

Two other specimens (No. 5,792, South Carolina, and No. 49,682, Arizona) are very similar in colors to the last; their measurements may be found in the appended table.

The following detailed descriptions of young birds are of specimens typical of the two supposed geographical styles:—

Young male (55,498, Fort Macon, N. C., February; Dr. Coues. Type of var. *cooperi* in Hist. N. Am. Birds, iii, p. 231):—Above grayish-umber, the feathers of forehead, crown, and nape faintly edged with pale rusty; occiput unvaried blackish, feathers white beneath the surface. Wing-coverts, scapulars, and interscapulars narrowly bordered with pale yellowish-umber; rump and upper tail-coverts bordered with rusty. Tail paler and grayer than the back, narrowly tipped with white, and crossed by four bands of brownish-black, the first of which is only partially concealed. Scapulars and upper tail-coverts showing much concealed white, in form of roundish spots, on both webs. Beneath, clear white, without any yellowish tinge; throat with a medial and lateral series of clear dark-brown streaks; jugulum, breast, sides, flanks, and abdomen with numerous stripes of clear sepia, each showing a darker shaft-streak; tibiæ with longitudinal streaks of paler and more rusty brown; lower tail-coverts immaculate.

Young female (6876, "Sacramento Valley, Cal."; Dr. Heermann—probably from Pennsylvania. Type of var. *cooperi* in Hist. N. Am. B., iii, p. 231):—Similar to young male, but more varied. The black middle streaks of feathers of head above narrower, causing more conspicuous streaks; white spots of scapular region considerably exposed; longitudinal stripes beneath narrower and more sparse.

Young male (Fort Tejon, Cal., type of var. *mexicanus*, *tom. cit.* 232):

—Forehead, crown, occiput, and nape deep rusty-brown; feathers with broad longitudinal streaks of deep black. Rest of upper parts deep umber, darkest on the back; feathers of back and rump, the upper tail-coverts, scapulars, and wing-coverts broadly bordered with rusty; scapulars with concealed white spots. Tail ashy-umber, tipped (more broadly than in adult) with ashy-white, crossed by four broad bands of brownish-black, the last (or subterminal) of which is broadest, the first concealed by the coverts. Secondaries and primaries similar in color to the tail, but darker; the first showing five indistinct darker bands, and tipped (rather broadly) with pale cinnamon-rufous. Ear-coverts and cheeks fulvous-white, thickly streaked with dark brown. Lower parts white, washed with ochraceous on jugulum and breast; each feather with a central longitudinal lanceolate stripe of clear umber, the shaft black; these streaks are very narrow on the throat, broadest on the breast and flanks. Tibiæ with transversely ovate spots and transverse bars of reddish-umber; lower tail-coverts with narrow shaft-streaks of darker brown. Lining of wing with cordate and ovate spots of dark brown.

Young female (42136, Orizaba, Mexico; M. Botteri. Type of var. *mexicanus* in Hist. N. Am. B., 232):—Similar to the young male, but feathers of back, etc., less broadly margined with rusty; ochraceous wash on lower parts more decided; stripes beneath broader and less lanceolate, on the sides broadly ovate, and on the flanks in form of broad transverse bars; tibiæ more thickly spotted transversely; lower tail-coverts immaculate. Wing, 9.00; tail, 7.80; tarsus, 2.25; middle toe, 2.50. Fourth quill longest; third shorter than fifth; second intermediate between sixth and seventh; first, 2.90 shorter than longest. Graduation of tail, 0.90.

Remarks.—Although occasional individuals from Mexico lead at first to the impression of a decided difference from the usual style of the Eastern United States, they lose their apparently distinctive features when a large series is brought together for comparison. As a rule, adult males from Mexico and the western districts of the United States agree with each other, and differ from the *average* style of the same plumage in birds from the Eastern United States in having the rufous of the lower parts in greater amount in proportion to the white, that of the tibiæ being often almost unbroken; there is usually also less of concealed white on the scapulars. The most typical example of the so-called *A. mexicanus*, however, is one from Massachusetts, described on p. 99. The difference between eastern and western birds of this species is more marked in the young than in the adult plumage, however; and there seems to be great constancy in the differences observable. Thus, the western birds are darker-colored throughout, the brown markings occupying larger areas, and the white portions of a less pure color, being more or less suffused or stained with pale ochraceous. The markings on the tibiæ are almost always transversely-cordate spots instead of longitudinal streaks. This darker style of plumage is characteristic of the entire Western Province, east to the Missouri Plains; but along the southern border and in Mexico, birds more like the eastern style seem to prevail.

Upon the whole, it is found impossible to characterize by tangible, and, at the same time, constant, characters, two geographical races of this species; for, while a barely appreciable difference characterizes the majority of the birds of either region, the cases of individuals which correspond in every particular being found in the region of which they are not typical are too numerous to warrant the considera-

tion of the two extremes as strictly climatic. It remains, therefore, for us to better class these variations as of an individual nature; and this stand-point is well borne out by the results of careful measurements of specimens from various localities in North America. The following table of measurements shows conclusively that the variations in general size and relative proportions of the parts are purely individual.

Measurements of thirty-nine specimens of NISUS COOPERI *from various portions of North America.*

ADULT MALES.

Wing.	Tail.	Culmen.	Tarsus.	Middle toe.	Catalogue No.	Museum.	Locality.
9.35	8.30	0.68	2.45	1.55	10086	National Museum	——?
9.40	8.30	0.68	2.50	1.55	2554	R. R	Washington, D. C.
9.20	8.15	0.65	2.55	1.50	66237	National Museum.	Massachusetts.
9.30	8.15	0.60	2.45	1.50	6874	....do	Sacramento Valley, Cal.
9.10	8.20	0.65	2.60	1.50	12024	....do	Fort Tejon, Cal.
8.85	7.80	0.65	2.40	1.45	42074	....do	Mirador, Mexico.
9.40	8.10	.....	2.30	1.55	23809	....do	Do.
8.90	8.00	0.62	2.45	1.85	5841	....do	Puget Sound.
9.25	8.60	0.60	2.35	1.55	1593	Aiken	El Paso, Co., Colo.
9.20	8.00	0.65	2.65	1.60	*a.* 15	Lawrence	New York.
9.10	7.90	0.65	2.35	1.65	*b.* 15	....do	Do.

ADULT FEMALES.

10.80	9.00	0.75	2.65	1.85	26588	National Museum.	Washington, D. C.
10.50	9.00	0.80	2.85	1.85	5792	....do	South Carolina.
10.40	9.40	0.75	2.70	1.75	49683	....do	Arizona.
10.10	9.30	0.75	2.65	1.60	55018	....do	Mazatlan, Western Mexico.
10.35	9.40	0.70	2.80	1.70	57867	....do	Tehuantepec, Southern Mexico.
10.20	9.10	0.70	2.60	1.62	1612	Aiken	Colorado.
10.00	9.10	0.70	2.70	1.62	1654	....do	Do.

YOUNG MALES.

9.40	8.20	0.65	2.65	1.55	25201	National Museum	Washington, D. C.
9.25	8.90	0.65	2.65	1.65	58340	....do	Jacksonville, Fla.
9.15	8.60	0.60	2.65	1.60	55498	....do	North Carolina.
8.90	8.30	0.60	2.60	1.50	19117	....do	Wyoming Territory.
9.00	8.80	0.60	2.30	1.45	5165	....do	Dakota Territory.
9.10	8.60	0.60	2.45	1.45	5847	....do	Washington Territory.
8.70	8.35	0.60	2.40	1.45	4590	....do	Do.
8.90	8.50	0.60	2.40	1.50	1759	R. R	Nevada.
9.00	8.30	0.60	2.50	1.50	.....	National Museum.	Fort Tejon, S. Cal.
9.00	8.40	0.60	2.55	1.52	628	R. R	Cape St. Lucas.
9.30	8.30	0.60	2.50	1.40	17208	National Museum	Do.
8.90	8.00	0.60	2.40	1.50	17209	....do	Do.
9.45	8.80	0.60	2.45	1.50	42073	....do	Mirador, Eastern Mexico.
9.15	8.40	0.58	2.35	1.45	33554	....do	Do.
8.80	8.70	0.60	2.45	1.50	32500	....do	Orizaba, Mexico.
9.15	8.80	0.55	2.45	1.48	.....	C. E. A	El Paso County, Colorado.

YOUNG FEMALES.

10.00	9.00	0.72	2.70	1.70	38255	National Museum.	Nebraska.
10.70	9.80	0.75	2.85	1.80	60868	....do	Southern Illinois.
10.60	10.00	0.80	2.85	1.85	955	R. R	Do.
10.50	9.80	0.70	2.70	1.65	17510	National Museum.	Montana Territory.
10.50	9.80	0.70	2.65	1.65	28114	....do	Northern California.

List of specimens in United States National Museum.

Catalogue No.	Corresponding No. of.	Original No.	Nature of specimen.	Sex and age.	Locality.	When collected.	From whom received.	Collected by—
4352					Presidio, Cal		Lieut. W. P. Trowbridge.	
4590	9			♂juv.	Fort Steilacoom, W. T		Dr. Potts	
4619				♀juv	Colorado River	Oct. 28, 1854	Maj. Emory	A. Schott.
5163	3				Fort Berthold, Dak	Sept. 16, 1856	Lieut. Warren	F. V. Hayden.
5164	2				Mouth White Earth River.	Sept. 6, 1856	do	Do.
5165	1			♂juv.	Mouth Yellowstone River.	Aug. 18, 1856	do	Do.
5578		383			Republican Fork	Aug. 17, 1856	Lieut. Bryan	W. S. Wood.
5579	4				Bridger's Pass	Aug. 14, 1856	do	Do.
5792				♀ ad.	Society Hill, S. C	Apr. 30, 1855	M. A. Curtiss	
5841	6	574		♂ ad.	Puget Sound, W. T	Oct. 4, 1856	Dr. Geo. Suckley	
5846	7	538			Port Townsend, W. T	Aug. —, 1856	do	
5847	8	539		♂juv.	Fort Steilacoom, W. T	Sept. —, ——	do	
6847					Fort Thorn, N. Mex		Dr. T. C. Henry	
6848	11				Bodega, Cal	Feb. —, 1855	Lieut. Trowbridge	T. A. Szabo.
6849	5				Fort Thorn, N. Mex		Dr. Henry	
6874	12			♂ ad.	Sacramento Valley, Cal		Lieut. Williamson	Dr. Heermann.
6876					do		do	Do.
8511		585			Fort Steilacoom, W. T	Oct. 10, 1856	Dr. Suckley	J. G. Cooper.
8512		585			Yakima River, W. T	Sept. 10. 1856	do	
10086				♂ ad.	Washington, D. C		J. C. McGuire	
10088					do		do	
10758					Fort Bridger, Wyo	Sept. 10, 1858	C. Drexler	
11791		176			Simiahmoo, W. T	July 16, ——	A. Campbell	Dr. Kennerly.
12024			M.	♂ ad.	Fort Tejon, Cal		J. Xantus	
17206		3344			Cape St. Lucas	Oct. 3, 1859	do	
17207		3297			do	Oct. 26, 1859	do	
17208		3069		♂juv.	San Nicolas, L. Cal	Oct. 26, 1859	do	
17209		3068		♂juv.	do	Oct. 26, 1859	do	
17211					Mira Flores, L. Cal	Nov. —, 1859	do	
17510				♀juv.	Walla Walla		Lieut. Mullan	J. Pearsall.
18454					Camp Burgwyn, N. Mex		W. W. Anderson	
18455					do		do	
18496					do	Apr. —, 1860	do	
19117				♂juv.	Rose Bend, Mo. River.		Capt. Reynolds	D. R. Hines.
21335		21			Yreka, Cal	Sept. 13, ——	William Vuille	
21336		23			do	Oct. 7, ——	do	
21465					Pennsylvania		John Heptune	
21469					do		John Krider	
22026		92			Bitterroot Valley	Aug. 2, 1860	J. G. Cooper	
22560					Pennsylvania		Dr. Leib	
23809		2		♂ ad.	Mirador, Mexico		Dr. C. Sartorius	
25201				♂juv.	Washington, D. C	Oct. —, 1841	———	
26586				♀ ad.	do		E. Coues	
28114		199		♀juv.	Fort Crook, Cal	Sept. 10, 1861	D. F. Parkinson	
32500		144		♂juv.	Orizaba, Mexico		F. Sumichrast	
33554		142		♂juv.	Mirador, Mexico	Oct. —, 1866	Dr. C. Sartorius	
38255				♀juv.	Fort Laramie	Apr. —, 1864	Dr. R. B. Hitz	
41903		46			West Kansas		A. Crocker	
42047		201			Mirador, Mexico		Dr. Sartorius	
42073		200		♂juv.	do		do	
42074				♂ ad.	do		do	
42136		141		♂juv.	Orizaba, Mexico		Botteri	
46621				♂ ad	Mount Carmel, Ill	Jan. 16, 1867	R. Ridgway	
46222				♂juv	do	Dec. —, 1866	do	
49663				♀ ad.	Arizona			
51295		296		♀juv.	El Mojon, Costa Rica	Dec. 30, 1867	Dr. A. von Frantzius	José C. Zeledon.
53203		240		—juv.	W. Humboldt Mts., Nev	Oct. 8, 1867	Clarence King	R. Ridgway.
55016		616		♀ ad.	Mazatlan, Mexico	Feb. 1, ——	A. J. Grayson	
55498		1610		♂juv.	Fort Macon, N. C	Feb. —, 1869	Dr. E. Coues	
57867				♀ ad.	Tehuantepec, Mexico		F. Sumichrast	
58340		2024		♂juv.	Jacksonville, Fla	Jan. 13, 1869	C. J. Maynard	
59054					Iowa		L. E. Ricksecker	
59156				♂juv.	Fort Tejon, Cal		J. Xantus	
59264		377			Washington, D. C	Sept. 18, 1860	Dr. Prentiss	
59990					Fort Whipple, Ariz	—— —, 1869	E. Palmer	
60623		558		♂juv	Uintah Mountains	Sept. 24, 1870	F. V. Hayden	H. D. Schmidt.
60665		865		♀juv.	Mount Carmel, Ill	Aug. —, 1869	R. Ridgway	S. Turner.
61500					Nevada	Sept. 16, 1871	Lieut. Wheeler	Ferd. Bischoff.
62172			M.	♂ ad.	California		Expl. Exp. (?)	
65322		231			Little Porcupine River	Aug. 8, ——	J. A. Allen	
66237		172		♂ ad.	Westfield, Mass	Oct. 10, 1846	Wesleyan University	
67345				♂juv.	Fort Tejon Cal		J. Xantus	
67346		602		♀juv.	Goodwin, Ariz	Sept. 20, 1873	Lieut. Wheeler	H. W. Henshaw.
67347		899		♀juv	San Pedro, Ariz	Oct. 1, 1873	do	Do.
67348		616		♀juv.	Apache, Ariz	Aug. 26, 1873	do	Do.

Other specimens examined.—In mus. Acad. Nat. Sci., Philadelphia, 18; American Mus., New York, 3; Boston Soc. N. H., 4; Mus. Comp. Zoöl., Cambridge, 3; G. N. Lawrence, 9; W. S. Brewer, 1; L. Jony, 1; C. E. Aiken, 1; S. F. Baird, 6; R. Ridgway, 7. Total number of specimens examined, 128.

Collectors' notes on color of eyes, etc., including fresh measurements (National Museum specimens).

No. 4352: length, 18.00; extent, 31.00.
No. 5163: length, 17.00; extent, 29.25; iris light yellow.
No. 5164: length, ——?; extent, 30.50; iris light yellow.
No. 5578: length, 18.25; extent, 25.00.
No. 5579: length, 15.00; extent, 24.00.
No. 5846: length, 19.00; extent, 30.00.
No. 11791: length, 15.00; extent, 23.00.
No. 12024: length, 17,00; extent, 29.00.
No. 17206: length, 16.00; extent, 27.00.
No. 17207: length, 17.00; extent, 29.00.
No. 17208: length, 17.00; extent, 29.00.
No. 17209: length, 16.00; extent, 28.20.
No. 46621: length, 17.00; extent, 30.50; bill pale blue at base, growing gradually black at end; cere greenish-yellow; iris bright orange-red; tarsi and toes lemon-yellow.
No. 46622: length, 19.00; extent, 33.50.

NISUS GUNDLACHI.

Astur cooperi LEMBEYE, Aves de la Isla de Cuba, 1850, 17.—CABANIS, Journ. für Orn Nov. 1854, —.
Accipiter cooperii BREWER, Pr. Boston Soc. Nat. Hist. 1860, p.—.
Nisus pileatus LEMB. Av. Cuba, Supplement, p. 125.
Accipiter pileatus BREWER, Pr. Boston Soc. Nat. Hist. 1860, p.—.
Accipiter mexicanus BREWER, Pr. Boston Soc. Nat. Hist. 1860, p.—.
Accipiter gundlachi LAWRENCE, Ann. Lyc. N. Y. May, 1860, 252.—GUNDLACH, Repert. 1865, 224.—SCL. & SALVIN, Exotic Orn. xi, 1869, 170: Nom. Neotr. 1873, p. 120.—GRAY, Hand List, i, 1869, 33, No. 319.—SHARPE, Cat. Acc. Brit. Mus. 1874, 137 (foot-note).
Nisus cooperi var. *gundlachi* RIDGWAY, B. B. & R. Hist. N. Am. Birds, iii, 1874, 223

Hab.—Cuba (Nat. Mus.).

Diagnosis.—Adult male:—"Front, crown, and occiput sooty black; upper plumage dull bluish-ash, the feathers of the back with brownish margins; tail of the same color as the back, partly tinged with dull rufous, and crossed with four brown bars, three of which are imperfect, being but little developed on the outer webs; the outer bar, however, crosses both webs and is narrowly tipped with white. Quill feathers brown, having their shafts, as are also those of the tail feathers, reddish-brown; cheeks dusky ash; space forward of the eye pale dull rufous; a line of whitish feathers runs along the edge of the crown and extends over the eye; throat ashy-white, tinged with rufous; sides of the neck, upper part of the breast, and a band running to the hind-neck grayish-ash; lower portion of the breast and upper part of the abdomen rufous, the feathers very narrowly edged with dull white; lower part of the abdomen of a pale rufous, with transverse bars of dull white. Long feathers of the sides grayish-ash tinged with rufous and destitute of bars or spots; sides, just above the junction of the tail, plain rufous; thighs of a bright but rather pale rufous, the feathers having darker submarginal ends, terminating with very narrow edgings of dull white; under wing-coverts and axillars bright rufous barred with white. The feathers of the throat, breast, and sides have their shafts dark brown; upper tail coverts grayish-ash, lower white; bill horn-color, with a whitish mark on the tooth and also on the edge of the lower mandible near its base; legs greenish-yellow."*

"Length about 18 inches; wing from flexure 9⅜; tail 7¾; tarsus 2¾."—(Lawrence, *l. c.*)

* Dr. Gundlach (Lawrence, *l. c.* p. 7) adds:—Cere and cheeks (*i. e.* orbits?) greenish-yellow; feet pale yellow with a greenish hue; iris red; length 0.457; extent 0.807.

Young male (41,129, Cuba, Dr. Gundlach):—Above dark vandyke-brown, the feathers bordered inconspicuously with dark rusty; tail dull slate, narrowly tipped with ashy-white, and crossed with four broad bands of dusky, almost equal to the slate in width; beneath, white, much tinged on breast and tibiæ with reddish-ochraceous; thickly striped with umber-brown, except on crissum, the streaks on throat narrow and cuneate, those on breast broad, and on sides changing into broad transverse spots or bars; tibiæ thickly spotted transversely with more reddish, nearly rufous, brown; larger lower tail-coverts with narrow shaft-streaks of black. Occiput showing much concealed white, the ends of the feathers deep black. Wing, 8.60; tail, 7.50; culmen, 0.68; tarsus, 2.50; middle toe, 1.70.

Young female (41,128, Cuba, Dr. Gundlach):—Similar, but more thickly striped beneath, the dark markings about equaling the white in extent; whole sides with large transverse spots of umber, cuneate along shafts. Wing, 10.50; tail, 9.50.

Remarks.—In regard to its relationship to its nearest allies, *N. cooperi* and *N. pileatus*, Mr. Lawrence (*l. c.* p. 8) remarks of this species:—"A very marked feature in the adult of this species is the ash-color of the breast and sides, which does not exist at all in *cooperi;* the under surface is less marked with white than in that species; the thighs are of a nearly uniform rufous, which in *cooperi* are conspicuously barred with white; in the latter the under wing-coverts are white, with longitudinal spots of rufous-brown, whereas in *gundlachi* they are rufous barred with white. From *A. pileatus*, as figured in Pl. Col. pl. 205, it is also very different; the adult of that species has the top of the head dark slate, the upper plumage of a rather light slate-blue; wings, dark slate; tail, with four dark bands, whitish between; the under plumage pale whitish-blue; thighs, deep rufous; no appearance of bars on any part of the plumage; under tail-coverts, white; bill, bluish, under mandible yellow at the base; legs, yellow."

In the "History of North American Birds" (iii, p. 223, foot-note), this species is considered to be a geographical race of *N. cooperi;* and Mr. Sharpe, in his great work, the "Catalogue of the Accipitres, or Diurnal Birds of Prey, in the collection of the British Museum" (p. 137, foot-note), remarks that it "will probably prove on examination to be identical with the small, richly-colored form of *A. cooperi*, called by Swainson *A. mexicanus*". We have shown before that the latter is not entitled to recognition as even a race, though we had previously accorded it that rank, while Mr. Sharpe (*tom. cit.* p. 137) more properly places it among the synonyms of *N. cooperi*. In regard to the *N. gundlachi*, the erroneous conclusions of both authors were the result of lack of specimens for comparison, and too hasty examination of published descriptions. The above description of the adult, copied from the original paper by Mr. Lawrence (Annals of the Lyceum of Natural History of New York, vii, May, 1860, p. 252), shows clearly the perfect distinctness of this Cuban species from its North American ally as well as from all other species of the genus.

List of specimens in United States National Museum.

Catalogue No.	Corresponding No. of—	Original No.	Nature of specimen.	Sex and age.	Locality.	When collected.	From whom received.	Collected by—
41128	....	....	M.	♂ juv.	Cuba	.....	Dr. Gundlach	
41129	....	....	M.	♀ juv.	do	.....	do	

NISUS GUTTATUS.

Sparvius guttatus VIEILL. N. D. x, 1817, 325.—PUCHER. R. Z. 1850, 13.
Accipiter guttatus STRICKL. Orn. Syn. i, 1855, 110.—SCL. & SALV. Ex. Orn. xi, 1869, 169, 170, pl. lxxv; Nom. Neotr. 1873, 120.—GRAY, Hand List, i, 1869, 33.—SHARPE, Cat. Acc. B. M. 1874, 152.
Esparrero pardo y goteado AZARA, Pax. Par. i, 1802, 113.

Hab.—Paraguay and Bolivia.

"*Male* (nearly adult).—Above slaty grey, the head blackish, the nape varied with white; wings dull brown, the quills barred with darker brown, the interspaces ashy white below, so that the cross bars are more distinct, inner secondaries slaty grey like the back; tail ashy brown, narrowly tipped with white, and crossed with four bars of darker brown, lower surface ashy white, the bars more distinct except on outermost feather, where nearly obsolete; throat white, tinged with rufous, the feathers narrowly centered with black shaft lines; rest of under surface pale fawn-rufous, the thighs a little deeper-coloured, the breast mottled with white spots and half-bars; the sides of the face and neck clear slaty grey, the sides of the upper breast washed with the same colour; under tail-coverts white, with a few subterminal rufous spots; under wing-coverts and axillaries entirely pale rufous like the breast. Total length 15.2 inches, culmen .6, wing 8.5, tail 6.8, tarsus 2.4.

"*Adult female.*—Similar to the male but larger. Total length 18 inches, wing 10.5, tail 8.5, tarsus 2.65."

"*Hab.*—Paraguay and Bolivia."—(SHARPE, *l. c.*)

NISUS CHILENSIS.

Accipiter chilensis PHILIPPI & LANDB. Arch. f. Naturg. 1864, 43.—SCL. P. Z. S. 1867, 329.—SCL. & SALV. Ibis, 1868, 187 (Sandy Pt., Str. Magellan; Feb.); Ex. Orn. v, 1868, 73, 170, pl. xxxvii (adult and young); xi, 170; Nom. Neotr. 1873, 120.—GRAY, Hand List, i, 1869, 33.—SHARPE, Cat. Acc. B. M. 1874, 155.
Nisus chilensis GIEBEL, Thes. Orn. 1872, 263.
Accipiter cooperi PELZ. Orn. Nov. 1865, 13 (not of Bonap.).

Hab.—Chile (NAT. MUS.); Straits of Magellan (KING).

Wing, 8.25–9.90; tail, 7.65–8.50; culmen, 0.50–0.70; tarsus, 2.25–2.65; middle toe, 1.40–1.70. Fourth and fifth quills longest; first shortest; outer five with inner webs emarginated. Tail slightly rounded.

Adult female (specimen in Mus. Philad. Acad.*):—Above, sooty slate-color, darker anteriorly; tail narrowly tipped with white, and crossed with five or six bands of black. Tibiæ plain rufous; crissum immaculate white; other lower parts except throat barred or transversely spotted with umber-brown, these markings tinged with rufous and slate-color, and connected by dark shaft-streaks. Wing, 9.65; tail, 8.50; culmen, 0.70; tarsus, 2.50; middle toe, 1.70.

Young male (No. 32,978, Nat. Mus.):—Above, dark grayish-sepia, growing gradually darker anteriorly; all the feathers with terminal borders of rusty-ochraceous, these whiter on the ends of the secondaries; scapulars, larger wing and upper tail-coverts with concealed white spot ting. Occipital feathers white, with terminal cuneate or tear-shaped spots of brownish-black, but the white mostly concealed. Nuchal feathers light tawny-ochraceous, similarly but more broadly marked. Tail grayish-brown, narrowly tipped with white, and crossed by five bands of dusky black, about as wide as the brown interspaces. Lower parts white, tinged with ochraceous-yellow on the breast, and with dilute

* This specimen is labeled, in Mr. Cassin's handwriting, "*F. linnæi*, nobis".

rufous on the tibiæ; crissum immaculate, but all other parts marked with brown, the breast, side, and abdomen having lanceolate streaks of clear dark brown, and the tibiæ having large transverse spots of lighter brown, mixed with rufous; throat with a medial series of narrow dusky streaks. Wing, 8.30; tail, 8.00; culmen, 0.52; tarsus, 2.45; middle toe, 1.40.

Adult female (No. 32,974, Nat. Mus.):—Exactly like the male. Wing, 9.85; tail 8.80; culmen, 0.60; tarsus, 2.80; middle toe, 1.70.

The sexes differ in measurements as follows:—

Males: Wing, 8.25–8.30; tail, 7.65–8.00; culmen, 0.50–0.53; tarsus, 2.25–2.45; middle toe, 1.40.

Females: Wing, 8.60–9.85; tail, 8.50–8.80; culmen, 0.60–0.62; tarsus, 2.65–2.80; middle toe, 1.70.

List of specimens in United States National Museum.

Catalogue No.	Original No.	Sex and age.	Locality.	When collected.	From whom received.
32977	....	♀	Chile	.....	Verreaux
32978	....	♂	...do	.....	...do
48827	16	♂	Chile, Valdivia	June —, 1864	Nat. Mus. Chile

NISUS BICOLOR.

Sparvius bicolor VIEILL. N. D. x. 1817, 325; Enc. Méth. iii, 1823, 1265.—PUCHER. R. Z. 1850, 92.

Cooperastur bicolor BONAP. Rev. et Mag. Zool. 1854, 538.

Accipiter bicolor STRICKL. Orn. Syn. i, 1855, 110.—SCL. & SALV. P. Z. S. 1869, 252 (Maruria, Venezuela); Ex. Orn. ix, 1869, 137, pl. lxix; *ib.* xi, 170; P. Z. S. 1870, 838 (coast of Honduras); P. Z. S. 1870, 787 (Venezuela); Nom. Neotr. 1873, 120.—GRAY, Hand List, i, 1869, 33.—SALVIN, P. Z. S. 1870, p. —(Veragua). —SHARPE, Cat. Acc. B. M. 1874, 154.

Nisus bicolor GIEBEL, Thes. Orn. 1872, 263.

Nisus pileatus var. *bicolor* RIDGW. Pr. Boston Soc. N. H. May, 1873, 89.

Nisus variatus LESS. Tr. 1831, 61.—PUCHER. R. Z. 1850, 6, 210.

Accipiter sexfasciatus SWAINS. An. Menag. 1837, 282.

Nisus sexfasciatus CABAN. Schomb. Reis. Guian. iii, 1848, 736.

Astur sexfasciatus LICHT. Nomencl. Av. 1854, 4.

Micrastur dynastes VERREAUX, in Bonap. Notes Orn. 1854, 4.

Rhynchomegus dynastes BONAP. Notes Orn. 1854, 4.

Accipiter erythrocnemis SCL. P. Z. S. 1860, 96 (not of Gray, 1848).

Accipiter pileatus SALVIN, Ibis, 1861, 354 (S. Mexico and Guatemala); *ib.* 1869, p. — (Costa Rica).—LAWRENCE, Ann. N. Y. Lyc. 1868, 134 (Costa Rica).

Hab.—Central District of Tropical America, from Southern Mexico to Ecuador and Guiana. Nicaragua, Costa Rica, and Surinam (Phila. Acad.); Costa Rica, Veragua, and Panama (Nat. Mus.); Cayenne (Boston Soc.).

Wing, 8.00–10.00; tail, 7.20–8.80; culmen, 0.55–0.75; tarsus, 2.25–2.70; middle toe, 1.45–1.80. Fourth and fifth quills longest; first shortest; outer five with inner webs emarginated. Tail slightly rounded.

Adult:—Pileum, plumbeous-black. Tibiæ bright cinnamon-rufous; lining of the wing white, usually mixed with grayish, or with darker shaft-streaks, and sometimes tinged with rufous along the outer border of the wing. Crissum white, sometimes tinged with grayish or rufous. Tail black, crossed by three to four narrow bands of dull plumbeous or slate, these indistinct on the upper surface, whitish underneath. Inner

webs of primaries marked with transverse spots of white. Rest of plumage continuous plumbeous, inclining to pearl-gray or ashy-blue on the lower surface (where the shafts of the feathers are usually conspicuously darker), and on the upper parts becoming gradually lighter toward the nape, which is bluish-plumbeous, abruptly contrasted with the black of the pileum.

Young:—Pileum brownish-black, bordered below by a continuous nuchal collar of unvariegated ochraceous. Rest of upper parts plain blackish-sepia, unbroken by any exposed white markings, and scarcely relieved by the narrow faint tips of fulvous to some of the feathers. Tail black, narrowly tipped with white, and crossed by four to five narrow bands of grayish-brown or mixed brown and white; these bands more regular, continuous, and almost entirely white on the under surface. Lower parts entirely ochraceous or white, paler on the crissum, and without any markings, except an occasional dusky shaft-streak here and there. Auriculars black.

Sexes alike in colors, but differing in size, as follows:—

Male:—Wing, 8.00–8.50; tail, 7.20–8.00; culmen, 0.55–0.60; tarsus, 2.25–2.40; middle toe, 1.45–1.50. (Six specimens.)

Female:—Wing, 9.50–10.00; tail, 8.60–8.80; culmen, 0.70–0.75; tarsus, 2.45–2.70; middle toe, 1.60–1.80. (Five specimens.)

The principal variations noticed among the few adults before us are quite trifling. The white of the lining of the wing and of the crissum is usually much clouded by a fine, irregular mottling of plumbeous; but in No. 61,363, ♂, from Veragua, there is none of this mottling, while the shafts of the feathers are conspicuously black. In No. 16,573, ♂, Panama (Frijole), the usual blackish shaft-streaks of the lower parts are almost obsolete. The plumbeous of the nape is also darker or lighter in different individuals, producing thereby a variable abruptness of contrast with the black of the pileum. The young plumage varies more. Some are nearly pure white beneath, but a light ochraceous shade is the more usual color of the lower parts. In a young male, however (43,047), from Costa Rica, the entire lower parts and the nuchal collar are deep tawny-ochraceous, almost rufous on the breast and thighs. A young female from Costa Rica (No. 39,733) is strikingly similar in all the details of coloration to the adult of *Micrastur melanoleucus*, even to the markings of the tail. The general form and the size, also, are so similar to the adult male of that bird that the generic characters only are different.

List of specimens in United States National Museum.

Catalogue No.	Original No.	Nature of specimen.	Sex and age.	Locality.	When collected.	From whom received.
16573	...	S.	♂ ad.	Panama Railroad	.....	McL
35182	..	S.	♀	San José, Costa Rica	Sept. 4, 1864	Carmiol
39733	166	M.	♀ juv.	Costa Rica	Nov. —, 1863	A. von Frantzius
43047	17	M	♂ juv.	Costa Rica (Turrialba)	July 17, 1866	J. Cooper
47363		M.	♂ ad.	Costa Rica	July 30, 1866	Carmiol
62127	3704	S.	♂ ad.	Chiriqua	.....	O. Salvin
66333	11	S.	♂ juv.	Lipurio, Costa Rica	.....	W. M. Gabb
67868	...	S.	♀ ad.	do	.....	do

Other specimens examined.—Mus. Phila. Acad., 5; Boston Soc., 2; G. N. Lawrence, 5; American Mus., N. Y., 1. Total, 21.

NISUS PILEATUS.

Falco pileatus TEMM. Pl. Col. i, 1824, pl. 205.—MAX. Beitr. iii, 1830, 107.
Accipiter pileatus VIG. Zoöl. Journ. i, 1824, 338.—GRAY, Gen. i, 1849, 29; Hand List, i, 1869, 33.—BONAP. Consp. i, 1850, 32.—STRICKL. Orn. Syn. i, 1850, 109 (in part).—SCL. & SALV. Ex. Orn. xi, 1869, 170; Nom. Neotr. 1873, 120.—PELZ. Orn. Bras. i, 1871, *, 399.—SHARPE, Cat. Acc. B. M. 1874, 153.
Nisus pileatus LESS. Man. i, 1828, 98.—BURM. Th. Bras. ii, 1855, 73.—SCHL. Mus. P.-B. Astures, 1862, 36; Rev. Acc. 1873, 70.
Nisus pileatus var. *pileatus* RIDGW. Boston Soc. Pr. N. H. May, 1873, 89.
Cooperastur pileatus BONAP. Rev. et Mag. Zool. 1854, 538.
Falco beskii LICHT. Nom. Av. 1854, 4.

Hab.—Brazil.

Wing, 8.10–10.40; tail, 6.80–9.00; culmen, 0.50–0.70; tarsus, 2.20–2.65; middle toe, 1.35–1.70. Fourth and fifth quills longest, first shortest; outer five with inner webs emarginated. Tail slightly rounded.

Adult:—Uniform plumbeous, except on the pileum, tibiæ, crissum, lining of the wing, remiges and rectrices; darker above, lighter beneath, where inclining to bluish-gray, the shafts conspicuously darker; pileum black; tibiæ and lining of wing uniform cinnamon-rufous; crissum white, somewhat tinged with gray. Tail crossed by four to five wide bands of black, the interspaces grayish-brown above, white on the under surface. Inner webs of primaries marked with transverse spots of white or mottled gray and white.

Young:—Above, dark sepia brown, the feathers bordered terminally with rusty, the scapulars, upper tail-coverts, and inner secondaries with conspicuous, large, transverse spots of white, many of them exposed. Pileum blackish, with rusty-ochraceous streaks in the superciliary region. Nape ochraceous, each feather with a central ovate stripe of blackish-brown; sides of neck similar; cheeks more finely streaked. Tail narrowly tipped with white, and crossed by four or five wide bands of brownish-black, the interspaces being grayish-brown (sometimes mixed with white) on the upper surface, and white on the lower. Lower parts ochraceous or ochraceous-white, the side of the breast with lanceolate stripes of blackish-brown, the sides with similar but broader stripes, or with broad spots; crissum immaculate. Lining of the wing ochraceous, usually more or less spotted.

Sexes alike in color, but differing in size, as follows:—

Male:—Wing, 8.10–8.40; tail, 6.80–7.20; culmen, 0.50–0.60; tarsus, 2.20–2.30; middle toe, 1.35. (Five specimens.)

Female:—Wing, 9.80–10.40; tail, 8.70–9.00; culmen, 0.66–0.70; tarsus, 2.50–2.65; middle toe, 1.65–1.70. (Seven specimens.)

Specimens of this species vary considerably, especially those in the young plumage. An adult in the museum of the Boston Society of Natural History (No. 573, Lafresnaye collection) differs from all others we have seen, in having the abdomen and sides strongly tinged with rufous. Two young examples before us differ quite conspicuously in the markings of their lower parts: No. 50,937 is deep ochraceous beneath, the tibiæ free from markings, with the exception of two or three small lanceolate streaks on the longer feathers of one thigh. The other specimen (No. 50,936) is nearly white beneath, the tibiæ deeper ochraceous, and thickly marked with large spots of brown. In this specimen, the light bands on the middle tail-feathers become white next the shaft. Both are females, in very young plumage.

List of specimens in United States National Museum.

Catalogue No.	Nature of specimen.	Sex and age.	Locality.	From whom received.
50934	S.	♀ ad...	Brazil	Sr. Don F. Albuquerque.
50935	M.	♀ ad...	....do	Do.
50936	S.	♀ juv...	....do	Do.
50937	S.	♀ juv...	....do	Do.
50940	M.	♂ ad...	....do	Do.

Other specimens examined.—In Mus. Boston Society, 7; Mus. Comp Zoöl., 1. Total, 13.

NISUS FUSCUS.

Falco fuscus GMELIN, S. N. i. 1788, 283.—LATH. Ind. Orn. 1790, 43; Gen. Hist. i, 1821, 283.—MILL. Cim. Phys. 1796, pl. xviii.—DAUD. Tr. Orn. ii, 1800, 86—SHAW, Zoölogy, vii, 1809, 161.—AUDUBON, B. Am. 1821, pl. 374; Orn Biog. iv, 1838, 522.—NUTTALL, Man. 1833, 87.—TOWNSEND, Journ. Ac. Nat. Sci. Philad. viii, 1839. p. —.—PEABODY, Boston Journ. N. H. iii, 1841, 78 (Mass.).—READ, Pr. Ac. Nat. Sc. Phila. 1853, p. — (N. Ohio).—BREWER (ed. Wilson), Am. Orn. 1852, 685.—THOMPSON, Nat. Hist. Vermont, 1853, 61.

Accipiter fuscus BONAP. Comp. List, 1838, 5; Consp. Avium, i, 1850, 33.—GRAY, Genera of Birds, fol. 1844, sp. 4; List Acc. Brit. Mus. 1844, 38; Hand List, i, 1869, 32.—CASSIN, Proc. Ac. Nat. Sci. Phila. 1848, p. — (Jalapa; resident); *ib.* 1855, 279; Illustr. Birds Cal. Tex. etc. 1856, 95; Birds N. Am. 1858, 18.—BAIRD, Stansbury's Report, 1852, 314 (Salt Lake Valley); Catalogue Birds N. Am. 1859, No. 15.—WOODHOUSE, Sitgreave's Exp. 1853, 61.—HERRMANN, Pacific R. R. Rep. x, iv, 1853, 33.—NEWBERRY, *ib.* vi, 74.—HOY, Pr. Ac. Nat. Sci. Phila. 1853, p. — (Wisconsin); Smithsonian Rep. 1864, 437 (Missouri).—STRICKL. Orn. Syn. i, 1855, 108.—BREWER, N. Am. Oölogy, i, 1857, 18, pl. iii, figs. 23, 29, pl. v, fig. 54.—KNEELAND, Pr. Boston Soc. N. H. 1857, 233 (Keweenaw Pt., L. Superior).—SCLATER, Ibis, 1857, 125; P. Z. S. 1858, 294 (Oaxaca); 1864, 178 (city of Mex.).—XANTUS, Pr. Ac. Nat. Sci. Phila. 1859, 190 (S. California).—BARNARD, Smithsonian Rep. 1860, 434 (Pennsylvania).—COOPER & SUCKLEY, Pacific R. R. Rep. xii. ii, 1860, 146 (Washington Ter.).—BRYANT, Pr. Boston Soc. N. H. 1861, 104 (Bahamas).—BLAKISTON, Ibis, 1861, 317 (Saskatchewan).—BOARDMAN, Pr. Boston Soc. N. H., 1862, 122 (Calais, Me.).—VERRILL, *ib.* 137 (Anticosti I.); Pr. Essex Inst. iii, 1863, p —.—SAMUELS, Rep. Sec. Ag. Mass. 1864, p. —; Birds of New Eng. 1870, 31, 81.—DRESSER, Ibis, 1865, p. — (Texas).—COUES, Pr. Ac. Nat. Sci. Phila. 1866, p. — (Arizona); *ib.* 1871, 27 (Ft. Macon, N. C.); Pr. Essex Inst. 1868, p —; Pr. Boston Soc. 1868, 120 (South Carolina); Key to N. Am. Birds, 1872, 212; Check List of N. Am. B. 1873, 67; Birds Northwest 1874, 333.—LAWRENCE, Ann. Lyc. N. Y., 1866, p. —; *ib.* 1868, 134 (Costa Rica); Mem. Boston Soc. N. H. 1874, p. 298 (W. Mexico; biographical notes by A. J. Grayson).—COOPER, Am. Nat. 1868, p. — (Montana); Orn. California, 1870, 466.—TURNBULL, Birds E. Penn. 1869, p. —.—SALVIN, P. Z. S. 1870, p. — (Veragua).—MAYNARD, Naturalist's Guide, 1870, 163 (Mass); Proc. Boston Soc. N. H., 1871, 26 (Coos Co., N. H.)—DALL & BANN. Tr. Chicago Ac. Sc. i, 1870, 271 (Alaska).—RIDGWAY, Pr. Ac. Nat. Sc. Phila. 1870, 141; Am. Nat. 1871, p. — (S. Ill.).—ALLEN, Bull. Mus. Comp. Zoöl. ii, 1871, 319 (Florida).—PARKER, Am. Nat. 1871, p. 169 (Iowa).—ROSS, Birds of Canada, 1871, 4.—SNOW, Birds of Kansas, 1872, 2.—TRIPPE, Pr. Boston Soc. N. H. 1872, p. — (S. Iowa).—HATCH, Bull. Minn. Ac. Sc. 1874, 51 (Minnesota; summer).—ADAMS, Rambles, 1873, 297.—SCL. & SALVIN, Nom. Neotr. 1873, 120.—SHARPE, Cat. Acc. Brit. Mus. 1874, 135.—HENSHAW, Ann. Lyc. N. Y. xi, 1874, 10 (Utah).

Astur fuscus DE KAY, Zoöl. N. Y. ii, 1844, 17, pl. ii, fig. 2 (♂ *juv.*).—GIRAUD, Birds Long I. 1844, 19.—GAMBEL, Pr. Ac. Nat. Sci. Phila. 1846, p. — (California).—PRATTEN, Tr. Ill. Ag. Soc. 1853–4, 599 (S. Ill.).—KENNICOTT, *ib.* 581 (N. Ill.).—PUTNAM, Pr. Essex Inst. 1856, 204 (Mass.; resident).—WILLIS, Smithsonian Rep. 1858, p. 281 (Nova Scotia).—BLAND, *ib.* p. 289 (Bermuda).

Nisus fuscus KAUP, Contr. Orn. 1850, 64, 281.—SCHLEGEL, Mus. P.-B. Astures, 1862, 30; Revue Acc. 1873, 69.—RIDGWAY, Bull. Essex Inst. v, 1873, 165 (Colorado); *ib.* 1875, 22 (Nevada); Proc. Boston Soc. N. H. 1874, p. —; Ann. Lyc. N. Y. 1874, 181 (Illinois); B. B. & R. Hist. N. Am. B. iii, 1874, 224.—YARROW & HENSHAW, Rep. Orn. Spec. Wheeler's Exp. 1874, 49, 68 (Colorado and Utah).

Falco dubius GM. S. N. i, 1788, 281.—LATH. Ind. Orn. 1790, 43; Gen. Hist. i, 1821, 279.—DAUD. Tr. 1800, ii, 122.
Accipiter striatus VIEILL. O. A. S. 1807, pl. 14.—STRICKL. Orn. Syn. i, 1855, 109.
Falco vieillotinus SHAW, Gen. Zoöl. vii, 1809, 204.
Falco velox WILS. Am. Orn. v, 1812, 116, pl. xlv, fig. 1.—BONAP. Isis, 1832, 1137; Ann. N. Y. Lyc. ii, 1833, 29.
Accipiter velox VIG. Zoöl. Beecheys Voy. i, 1824, 338.
Astur velox JAMES. (ed. Wils.) Am. Orn. i, 1831, 68.
Falco pennsylvanicus WILSON, Am. Orn. vi, 1812, 1, pl. 46, fig. 1.
Accipiter pennsylvanicus STEPHENS, Zoöl. xiii, ii, 1815, 32.—VIGORS, Zoöl. Journ. i, 1824, 338.—SWAINSON, Fauna Bor.-Am. ii, 1831, 8, 44.—JARDINE (ed. Wilson), Am. Orn. i, 1831, 70.
Astur pennsylvanicus LESSON, Man. i, 1829, 92.—JAMESON (ed. Wilson), Am. Orn. i, 1831, 70.
Nisus pennsylvanicus CUVIER, Rég. An. i, 1829, 334.—LESS. Tr. Orn. 1831, 59.
Sparrius striatus VIEILLOT, Nouv. Dict. x, 1817, 338.
Nisus striatus CUVIER, Règ. An. i, 1829. 334.
Accipiter ardesiaceus VIEIL. Enc. Méth. iii, 1823, 1274.
Nisus malfini LESSON, Tr. Orn. 1831, 58.
Accipiter fringilloides JARDINE (ed. Wilson), Am. Orn. ii, 1832, 215. (Not of D'Orb. 1839, ex Vigors, 1828.)
? *Nisus pacificus* LESSON, Man. 1847, 177.

Hab.—Entire continent of North America, south to Panama; Bahamas, but not in Cuba (where replaced by *N. fringilloides*) or other West India Islands.

Wing, 6.35–8.80; tail, 5.50–8.20; culmen, 0.35–0.60; tarsus, 1.85–2.30; middle toe, 1.10–1.55. Fourth and fifth quills longest, third nearly equal to sixth, outer five with inner webs emarginated. Tail even or slightly emarginated.

Adult male:—Above plumbeous, becoming gradually darker on the pileum, the feathers with blackish shaft-streaks. Tail rather lighter, usually browner, (sometimes with a narrow white terminal margin), crossed with four dusky bands. Occipital feathers pure white beneath the surface, and scapulars with large concealed roundish spots of the same. Lower parts mixed white and rufous, in transverse spots or bars, the rufous bars usually connected along the middle of the feather, the shaft being conspicuously darker. Throat and cheeks streaked but not barred. Crissum and anal region immaculate pure white. Tibiæ usually with the rufous predominating, rarely uniform rufous. Wing, 6.70–7.10; tail, 5.80–6.10; culmen, 0.38–0.42; tarsus, 1.90–2.05; middle toe, 1.10–1.25.

Adult female:—Similar to the male, but less bluish above, and the white of the lower parts less pure. Wing, 7.80–8.80; tail, 6.60–8.20; culmen, 0.48–0.60; tarsus, 2.00–2.25; middle toe, 1.30–1.55.*

Young male:—Above dark sepia, the feathers bordered terminally with rusty, the feathers of the nape widely edged with the same, or with fulvous-whitish; feathers of the pileum similarly but more narrowly edged with the same. Tail brownish-gray, crossed by four to five well-defined, continuous, narrow bands of blackish. Scapulars and upper tail-coverts with concealed large spots of white, and occipital region white beneath the surface. Beneath, white, with or without an ochraceous tinge, the anal region and crissum immaculate, the throat streaked with dusky; the breast, abdomen, sides, and flanks with broad stripes of dilute sepia, with darker shaft-streaks, these stripes sometimes dilating on the sides into chain-like series of spots; tibiæ with elliptical or tear-shaped stripes, or variously-shaped spots, of dilute sepia, on a

* Terminal two-thirds of bill deep black; basal portion pale blue; interior of mouth bright cobalt-blue, more purplish far back; cere, rictus, eyelids, and naked "eyebrow" oil-green; iris deep orange-red; tarsi and toes browish lemon-yellow; claws jet-black (No. 956, Mus. R. R.).

white or pale rusty ground. Wing, 6.35–6.95; tail, 5.50–6.30; culmen, 0.35–0.40; tarsus, 1.85–2.05; middle toe, 1.05–1.25.

*Young female:**—Exactly like the young male in markings and colors. Wing, 7.75–8.60; tail, 6.50–7.60; culmen, 0.45–0.50; tarsus, 2.05–2.30; middle toe, 1.30–1.50.

To represent the average style of the adult male, we select a specimen from Pennsylvania, No. 59055, Nazareth; L. E. Ricksecker. In this example, the upper parts are a uniform plumbeous throughout, the pileum being hardly appreciably darker than the back, and the tail equally blue with other portions; the tail has a distinct, narrow, white, terminal border; the longer upper tail-coverts also have very narrow white tips. On the lower parts (*i. e.*, breast, sides, flanks, and abdomen), the white and rufous bars are about equal in width, the latter growing wider toward the shaft of the feathers, along which they are connected by a narrow streak of rufous, the shaft itself being blackish; the white bars being thus broken into transverse oblong spots.

There are now before us thirty examples of the adult of this species, and we have examined many more; and our conclusion is that the variations exhibited in the plumage are purely individual, having nothing to do with climatic causes, since the two darkest examples are from Chiriqui, New Granada, and Fort Bridger, Wyoming, and the two lightest-colored ones are from Guatemala and Fort Resolution, Hudson's Bay Territory, while others from the Atlantic States are not distinguishable from some obtained on the Pacific coast. As illustrating the extremes of variation in the adult plumage, we cite the following specimens:—

The lightest in the entire series is an adult male from Choctun, Vera Paz, Guatemala (January), in the collection of Mr. Salvin. In this, the upper parts are a light, decidedly bluish, plumbeous, with conspicuous black shaft-streaks, exceedingly similar to the dorsal surface of adult males of *Falco columbarius;* the pileum is decidedly darker, with the shaft-streaks less conspicuous, and the tail is decidedly more brownish than the upper coverts. There is a quite distinct narrow superciliary stripe of small white streaks. The general aspect of the lower parts is white, all the feathers except on the anal region and crissum with very conspicuous blackish shaft-streaks, these being rendered the more prominent by the faintness of the rufous markings, which are distinct only along the sides, and even on the tibæ are narrower than the white interspaces. A peculiar feature of this specimen, so far as the series before us is concerned, is that the dusky bands on the inner web of the primaries are broken into irregular cloudings, although they have a general tendency toward transverse bands.

A specimen from Fort Resolution, Hudson's Bay Territory, April 26 (No. 629, Mus. R. R.), is very similar, but the bars of the lower parts are better defined, although not deeper in color, and the upper parts are darker and more uniform plumbeous; the superciliary streaks are also concealed or nearly obsolete. In this specimen, as in many others, the rufous bars are bordered with a narrow, dark, slaty margin.

The darkest examples are an adult male in Mr. Salvin's collection (No. 3705) from the southern slope of the volcano of Chiriqui; one from Utah (Beaver, September, 24; No. 2130, Mus. R. R.); and one in the National Museum, from Fort Bridger, Wyoming (No. 10759, May 26). The two former are alike in their upper plumage, which is a very dark plumbeous, becoming gradualy but very perceptibly darker on the pileum, the shafts not conspicuously darker; the longer upper

* Iris sulphur-yellow; tarsi and toes rich lemon-yellow. (Fresh colors of No. 53204.)

tail-coverts and the tail itself have a narrow terminal margin of white. The lower plumage of these two is strikingly different, however, although in both the rufous greatly predominates over the white in amount. In the Chiriqui specimen, the rufous is nearly uniform across the breast, along the sides, and on the tibiæ, being broken on these parts only by small, transverse, oblong spots of white, these bars becoming larger on the abdomen, where the relative proportion of the two colors is about equal; the rufous markings lack the usual marginal suffusion of plumbeous, and the darker shaft-streaks are so nearly obsolete as to be seen only upon very close inspection. In the Utah specimen, the rufous markings of the lower parts are remarkable chiefly for their uniformity of size and distribution and for the distinctness of the marginal suffusion of plumbeous, which gives a peculiarly dark aspect to these markings. The darker shaft-streaks are also very distinct. The Fort Bridger specimen is in the worn and faded summer plumage, and is consequently lighter-colored than the two just described; but were it in recent possession of the winter dress, to correspond with these, it would be all but indistinguishable from the Chiriqui specimen, the tibiæ being uniform rufous, except on the front part, where broken by small white bars, and that of the sides, from breast to flanks, quite continuous.

The females present variations quite parallel with those of the males. The lightest in the series are No. 2499, Mus. R. R., Long Island, N. Y.; No. 54337, Nat. Mus., Yukon R., Alaska, and a specimen from Mexico, in Mr. Salvin's collection; the three being so extremely similar that the differences cannot be easily expressed. The darkest of the series are: one from Guatemala (No. 2264, Mus. O. Salvin; Jan.); No. 6954, Nat. Mus., Black Hills, Wyoming (August); No. 32499, Nat. Mus., Orizaba, Mex.; No. 8513, Nat. Mus., Camp Yuma, Colorado R., California (Dec.); and one from the District of Columbia (No. 49, Mus. L. Jouy); and these, also, are very much alike. A specimen from Saticoy, California (No. 63647, Nat. Mus.; Nov. 14), exhibits, to a greater extent than any other before us, an ashy shade on the sides of the breast, and a grayer cast to the rufous bars of the anterior lower parts; but the difference in this respect from other specimens is not conspicuous.

In the young plumage, the individual variation is much more remarkable than in the adult; but the variation seems to be essentially individual, although most specimens from the Northwest Coast region (Oregon to Sitka) are darker in their shades of color than those from other portions of the continent. This, however, is a mere tendency to climatic variation, since there are specimens in the series before us which are indistinguishable from these Northwest Coast examples; the localities thus represented being the Souris River, Dakota, Orizaba, Mexico (No. 37428), Lower California (No. 17210), and Fort Tejon, Upper California (No. 12023). The darkest individuals, however, are No. 45828, ♂ juv., Sitka, August, and No. 5845, ♀ juv., Fort Steilacoom, Washington Territory, August. In these, the upper parts are a blackish sepia, with the terminal borders of the feathers dark rusty, almost chestnut. The tibiæ are pale rufous, with deeper rufous spots; the markings of the breast are deep sepia, broadly sagittate, those of the sides decidedly transverse, and widely connected along the middle of the feathers, while those on the abdomen are acute-ovate.

Specimens from the Atlantic States are palest, two from the District of Columbia (♂ juv., No. 2561, Mus. R. R., and ♀ juv., No. 631, Mus. R. R.) being the lightest-colored examples in the entire series of seventy-three specimens. In these, the upper parts are grayish-sepia, with the

terminal margins of the feathers rather fulvous than rusty; the lower parts are pure white, the markings being dilute sepia, those of the breast in the form of narrow stripes, those of the abdomen tear-shaped and acicular, while on the sides each one dilates into two ovate spots; those of the tibiæ are chain-like, the ovate spots connected by a narrow streak. Several specimens similar to these from Guatemala are in Mr. Salvin's collection. Many young females, not remarkable for either darkness or lightness of colors, have the spots on the sides so decidedly transverse as to appear like wide bars, connected, however, along the shaft.

The adult plumage of this species is acquired at the first moult; but before this takes place, the plumage becomes much worn and faded, the upper parts being grayish-brown, the rusty terminal margins to the feathers absent or very indistinct, and the markings of the lower parts lighter and more sandy-brown. Three specimens in the collection (No. 3134, Mus. R. R., ♀ juv.; No. 67342, Nat. Mus., ♀ juv.; and No. 19384, Nat. Mus., ♀ juv.) represent this stage.

List of specimens in the United States National Museum.

Catalogue No.	Corresponding No. of—	Original No.	Nature of specimen.	Sex and age.	Locality.	When collected.	From whom received.	Collected by—
4198	12			♀ juv.	San Francisco, Cal	Winter of 1853–54.	R. D. Cutts	
4511					do		Lieut. Williamson	Dr. Newberry.
4512	11				do		do	Do.
4589					Fort Steilacoom, W. T.		Dr. Potts	
5575	1				Saranac Lake, N. Y.	Aug. —, 1855	S. F. Baird	
5584	6	262		♂ juv.	Bridger's Pass, Rocky Mountains.	Aug. 14, 1856	Lieut. Bryan	W. S. Wood.
5842	9	543			Fort Steilacoom, W. T	Sept. —, 1856	Dr. Suckley	
5843		542			do	Sept. —, 1856		
5844	10	541			do	Sept. —, 1856		
5845	8	544		♀ juv.	do	Sept. —, 1856		
5990	2			♂ juv.	Orange, N. J.	Oct. —, ——	Dr. J. G. Cooper	
6867	13				Tejon Valley, Cal.		Lieut. Williamson	Dr. Heermann.
6907	4				Selkirk Settlement			
6908	3							
6954	5	387		♀ ad.	Black Hills	Aug. 11, 1857	Lieut. Bryan	W. S. Wood.
7599	2				Washington, D. C		W. Hutton	
8013	7			♀ ad.	Camp Yuma, Cal	Dec. —, 1854	Major Emory	A. Schott.
8405					Puget Sound, W. T.	Aug. 30, 1857	A. Campbell	J. G. Cooper.
8513	14			♀ ad.	Camp Yuma, Cal	Dec. —, 1854	Major Emory	
8514	11	98		♂ juv.	Shoalwater Bay, W. T.	Sept. 23, 1854	Governor Stephens	
8642	2b		M.	♂ juv.	Cape Florida, Fla.	Nov. 2, 1857	G. Würdemann	
9064					Black Hills		Lieut. Warren	
9509		67				Nov. 4, ——	A. Campbell	
10059					Fort Bridger, Wyo	May 26, 1858	C. Drexler	
10060					do	Sept. 16, 1858	do	
10089			M.	♂ ad.	Washington, D. C		J. C. McGuire	
10759		452		♂ ad.	Fort Bridger, Wyo	May —, 1858	C. Drexler	
11598					Cant. Burgwyn, N. Mex		W. W. Anderson	
11791				♀ juv.	Simiahmoo, W. T.	July 16, 1858	A. Campbell	C. B. Kennerly.
11990			M.	♂ ad.	Washington, D. C	Apr. 28, ——	H. A. Falls	
12019			M.		do			
12020			M.		do		H. O. Birch	
12023			M.	♀ juv.	Fort Tejon, Cal.		J. Xantus	
12118			M.	♀ juv.	"United States"			
13110			M.		Cant. Burgwyn, N. Mex		W. W. Anderson	
13286		117			Big Sandy Creek	Aug. 28, 1858	Capt. J. H. Simpson	
16757		165		♀ juv.	Hudson's Bay Terr.		Captain Blakiston	
16999				♀ juv.	East Winsor, Conn.		Dr. W. Wood	
17210		3067			San Nicolas, Lower California.	Oct. —, 1859	J. Xantus	
17211		3417			Mira Flores, Lower California.	Nov. 25, 1859	do	
17518					Sun River, Dak.		John Pearsall	
17519					do		do	
18405		26			West of Fort Benton		Lieut. Mullen	
19116		154	M.	♀ ad.	Border River	Oct. 1, ——	Captain Reynolds	
19117		182			Rose Bend	Sept. 9, ——	do	Dr. Hines.
19383					Fort Resolution, Hudson's Bay Territory.	Apr. 26, ——	R. Kennicott	
19384				♀ juv.	do	June 16, ——	do	

List of specimens in the United States National Museum—Continued.

Catalogue No.	Corresponding No. of—	Original No.	Nature of specimen.	Sex and age.	Locality.	When collected.	From whom received.	Collected by—
21337		24			Yreka, Cal	Oct. 6, —	W. Vuille	
21338		24		♂juv.	do	Oct. 7, —	do	
21339		24			do	Oct. 18, —	do	
21470					Philadelphia, Pa		John Krider	
21471					do		do	
22026		82			Bitterroot Valley	Aug. 30, 1860	J. G. Cooper	
22566		4			La Pierre House	Sept. —, 1860	B. R. Ross	J. Flett.
24114		930			Fort Simpson	May —, 1861	do	
24610					Moose Factory		John McKenzie	
25910			M.	♂juv.	"United States"		Dr. Lieb	
25941					do		do	
27067		1110			Yukon, Alaska		R. Kennicott	
27068		1310			Fort Resolution		B. R. Ross	
27108		89			Mirador, Mexico		Dr. C. Sartorius	
27109					do		do	
30234		197		♀ ad.	Manzanillo Bay	Feb. —, 1863	J. Xantus	
30970		128			Washington, D. C	Oct. 22, 1861	C. E. Schmidt	
31357	72c9	147			Fort Rae, Great Slave Lake.	June 9, 1863	R. McFarlane	
31359		653			Fort Resolution	Sept. —, 1862	J. Lockhart	
32298					Moose Factory	Sept —, 1862	J. McKenzie	
32499				♀ ad.	Orizaba, Mexico		F. Sumichrast	
34694					Fort Union		E. T. D	
37429		17		♀juv.	Orizaba, Mexico	Dec. —, 1864	F. Sumichrast	
39401		119			Mount Carroll, Ill		H. Shimer	
41726		1194		♂juv.	Fort Whipple, Ariz		Dr. E. Coues	
41887			M.	♀juv.	Philadelphia, Pa		J. Krider	
41888			M.	♀juv.	do		do	
41889			M.	♀juv.	do		do	
41890			M.		do		do	
42136		141			Orizaba, Mexico		Bolten	
45926				♀juv.	Sitka, Alaska	Sept. —, 1866	Colonel Bulkley	Fred. Bischoff.
45927					do	May —, 1866	do	Do.
45928				♂juv	do	Aug. —, 1866	do	Do.
45976					do	Sept. —, 1866	do	Do.
45977					do	May —, 1866	do	Do.
45978					do	Aug. —, 1866	do	Do.
47793		847			Laredo, Tex	June —, 1867	Dr. H. B. Butcher	
47798		819			Koyonkuk, Alaska	Apr. 29, 1867	W. H. Dall	
50201					——?		——?	
50202					——?		——?	
51294		278		♂ ad.	El Mojon, Costa Rica	Dec. 1, 1867	Dr. A. von Frantzis	José C. Zeledon.
51295		296			do	Dec. 30, 1867	do	Do.
51704		223			Fort Yukon, Alaska		J. McDougall	
54299		267			Orizaba, Mexico		F. Sumichrast	
53904		917		♀juv.	Upper Humboldt Valley, Nev	Sept. 10, 1867	Clarence King	R. Ridgway.
54336				♂ ad.	Nulato, Alaska	May 1, 1868	W. H. Dall	
54337				♀ ad.	Yukon River, Alaska	May 1, 1868	do	
54364					Kadiak, Alaska	Mar. 15, 1869	F. Bischoff	
55016		647		♀juv	Mazatlan, Mexico	Jan. —, —	Col. A. J. Grayson	
55017		1130		♂ ad.	do	Jan. —, —	do	
57864				♀juv.	Tehuantepec, Mexico	Jan. 6, —	F. Sumichrast	
58137				♂juv	Kadiak, Alaska	Mar. 15, 1869	F. Bischoff	
59055			M.	♂ ad.	Nazareth, Pa		L. E. Ricksecker	
59262		570			Washington, D. C		Dr. D. W. Prentiss	
59263		372			do		do	
59504		975			Tehuantepec	Nov. —, 1869	F. Sumichrast	
59502		977		♀ ad.	do	Nov. —, 1869	do	
59942		1074			Fort Tejon, Cal		J. Xantus	
59943		3979			San José, Lower California.	Feb. —, 1860	do	
59944		1407			Fort Tejon, Cal		do	
60624		530			Uintah Mountains	Sept. 20, 1870	F. V. Hayden	H. D. Schmidt.
62234		228			Little Geyser Basin, Mont.	Aug. 20, 1872	do	C. H. Merriam.
62235		229			do	Aug. 20, 1872	do	Do.
62409		472			Provo, Utah	Nov. 30, 1872	Lieut. Wheeler	H. W. Henshaw.
63470		284			Beaver, Utah	Sept. 24, 1872	do	Do.
63471		301			Toquerville, Utah	Oct. 15, 1872	do	Do.
63647				♀ ad.	Saticoy, Cal	Nov. 14, 1872	J. G. Cooper	
63676					Labrador	Sept. —, 1868	W. Brewster	A. Lechavillier.
63677					Labrador?	Oct. —, 1871	do	Do.
67309		378			Souris River, Dak	Sept. 3, 1873	Dr. E. Coues	
67342		358		♀juv.	Denver, Col	May 9, 1873	Lieut. Wheeler	H. W. Henshaw.
67343		875		♂juv.	Camp Grant, Ariz	Sept. 24, 1873	do	Do.
67350		914		♀ ad.	Gila River, N. Mex	Oct. 15, 1873	do	Do.

Other specimens examined.—In mus. Philad. Acad, 14; American Museum, N. Y., 7; Boston Soc., 5; Comp. Zoöl., Cambridge, 9; G. N. Lawrence, 1; O. Salvin, 12; W. S. Brewer, 1; L. Jouy, 3; S. F. Baird, 2; R. Ridgway, 8. Total number of specimens examined, 182.

Measurements.

ADULT MALES.

Catalogue No.	Museum.	Date.	Locality.	Wing.	Tail.	Culmen.	Tarsus.	Middle toe.	Collected by—
59055	U. S		Nazareth, Pa.	6.80	5.80	0.40	1.90	1.10	L. E. Ricksecker.
11990	..do		District of Columbia	6.60	5.70	0.42	2.00	1.20	H. A. Falls.
10089	..do		.....do	6.90	6.00	0.40	2.00	1.18	J. C. McGuire.
2498	R. R.		Long Island, N. Y	6.80	5.90	0.40	2.00	1.15	J. H. Batty.
629	..do	April 26	Fort Resolution, Hudson Bay Territory.	7.00	6.00	0.38	2.00	1.25	
10759	U. S	May 26	Fort Bridger, Wyo.	6.90	5.90	0.40	1.95	1.15	C. Drexler.
2130	R. R.	Sept. 24	Beaver, Utah	7.00	6.10	0.40	2.00	1.20	H. W. Henshaw.
55017	U. S	Jan. —	Mazatlan, Western Mexico	7.10	6.00	0.40	1.95	1.18	A. J. Grayson.
2270	O. S.	..do	Guatemala (Choctun)	6.90	5.85	0.40	1.95	1.12	O. Salvin.
51294	U. S	Dec. 1	Costa Rica	6.70	5.80	0.40	1.90	1.20	J. C. Zeledon.
3705	O. S.		Chiriqui	6.90	5.80	....	1.95	1.10	E. Arce.
54336	U. S	May 15	Nulato, Alaska	7.00	6.10	0.40	2.05	1.20	W. H. Dall.
48	L. J.	Mar. —	District of Columbia	7.00	6.10	0.40	1.95	1.18	L. Jouy.

YOUNG MALES.

26940	U. S			6.70	5.70	0.40	1.95	1.25	
41890	..do		Philadelphia	6.50	5.50	0.40	1.90	1.15	J. Krider.
8632	..do		Cape Florida	6.70	5.90	0.38	1.85	1.15	G. Würdemann.
738	S. F. B.	Sept. 21	Carlisle, Pa.	6.40	5.50	0.35	1.85	1.20	S. F. Baird.
2561	R. R.	Dec. 1	District of Columbia	6.80	6.10	0.38	1.95	1.18	E. Coues.
2500	..do		Long Island, N. Y	6.70	6.00	0.35	1.90	1.20	J. H. Batty.
67343	U. S	Sept. 24	Camp Grant, Ariz	6.80	6.30	0.35	1.85	1.15	H. W. Henshaw.
21338	..do	Oct. —	Yreka, Cal.	6.60	6.00	0.35	1.90	1.20	W. Vuille.
630	R. R.	Oct. 6	.....do	6.95	6.50	0.40	1.90	...	Do.
41726	U. S	Mar. 11	Fort Whipple, Ariz.	6.95	5.80	0.38	....	1.15	E. Coues.
5584	..do	Aug. 14	Bridger's Pass	6.80	5.90	0.38	2.00	1.25	W. T. Wood.
5990	..do	Oct. —	Orange, N. J	6.70	5.90	0.40	1.85	1.12	J. G. Cooper.
8514	..do	Sept. 23	Shoalwater Bay, W. T	6.65	5.90	0.40	2.05	....	Do.
58137	..do	Mar. 10	Kadiak, Alaska	6.95	6.00	0.38	1.95	1.20	F. Bischoff.
45828	..do	Aug. —	Sitka, Alaska	6.90	5.90	0.40	2.00	1.20	Do.
37428	..do	Dec. —	Orizaba, Mexico	6.60	6.10	0.40	1.85	1.20	F. Sumichrast.
2265	O. S.	Nov. —	Guatemala (Colon)	6.35	6.00	0.40	1.90	1.15	O. Salvin.
	..do	Oct. 22	Guatemala (Dueñas)	6.55	5.50	0.38	1.85	1.05	Do.
2268	..do		.....do	6.70	5.90	0.38	1.90	1.20	Do.

ADULT FEMALES.

19116	U. S		Powder River	8.10	7.15	0.48	....	....	E. H. Trook.
2499	R. R.		Long Island	8.30	7.40	0.50	2.10	1.45	J. H. Batty.
49	L. Jouy		District of Columbia	8.20	7.00	0.50	2.20	1.45	L. Jouy.
956	R. R.	Oct. 22	Southern Illinois	7.80	6.70	0.50	2.12	1.30	R. Ridgway.
3134	..do	Oct. 5	.....do	7.80	6.60	0.55	2.20	1.40	J. L. Ridgway.
6954	U. S	Aug. 11	Black Hills	8.40	7.20	0.50	2.20	1.45	W. S. Wood.
8513	..do	Dec. —	Camp Yuma, Cal	8.00	7.35	0.50	2.10	1.40	A. Schott.
67350	..do	Oct. 16	Gila River, N. Mex	8.10	7.15	0.50	2.25	1.40	H. W. Henshaw.
63471	..do	Oct. 15	Toquerville, Utah	8.20	7.30	0.50	2.15	1.40	Do.
63647	..do	Nov. 14	Saticoy, Cal.	7.80	6.90	0.48	2.10	1.35	J. G. Cooper.
54337	..do	May 1	Yukon River, Alaska	8.20	6.90	0.50	2.20	....	W. H. Dall.
32499	..do		Orizaba, Mexico	8.05	7.20	0.50	2.20	1.45	F. Sumichrast.
59502	..do	Nov. 3	Tehuantepec, Mexico	8.10	6.90	0.52	2.20	1.40	Do.
2269	O. S.		Guatemala (Dueñas)	8.10	6.90	0.50	2.15	....	O. Salvin.
2271	..do	Nov. —	.....do	8.25	7.00	0.48	2.10	1.35	Do.
2264	..do	Jan. —	Guatemala (Choctun)	8.20	7.00	0.50	2.10	1.35	Do.
	..do		Mexico	8.10	7.00	0.50	2.15	1.45	Mr. Le Strange.

		Tarsus.	Middle toe.	Collected by—
[illegible]	50	2.25	1.35	S. F. Baird.
[illegible]	45	2.15	...	Dr. Wood.
[illegible]	50	2.15	1.40	E. Coues.
[illegible]	50	2.30	1.45	Capt. Blakiston.
[illegible]	48	2.10	1.35	D. W. Prentiss.
[illegible]	46	2.05	1.30	J. H. Batty.
[illegible]	48	...	...	L. Jony.
[illegible]	46	2.25	1.50	F. Bischoff.
[illegible]	48	2.20	...	G. Suckley.
[illegible]	48	2.30	1.45	C. B. Kennerly.
[illegible]	50	2.20	1.40	R. D. Cutts.
[illegible]	50	2.25	1.40	J. Xantus.
[illegible]	50	2.20	1.40	H. W. Henshaw.
[illegible]	50	2.15	1.45	A. J. Grayson.
[illegible]	48	2.10	1.35	F. Sumichrast.
[illegible]	50	2.25	1.40	J. Carmiol,
[illegible]	50	2.12	1.40	O. Salvin.
[illegible]	45	2.20	1.40	Do.
[illegible]	48	2.20	...	R. Kennicott.
[illegible]	50	2.20	1.40	J. Krider.
[illegible]	52	2.10	1.40	Do.
[illegible]	50	2.10	...	Do.
[illegible]	50	2.30	..	J. Xantus.
[illegible]	50	2.30	...	

[illegible] *ements* (*National Museum*

[illegible] yellow; bill black and

[illegible] List B. B. M. 1848, 71.—
[illegible] 355, 108 (sub *A. fuscus*).—
[illegible] Hand List, i, 1869, 32, No.
[illegible] te).
[illegible] B. Av. de la Isla de Cuba,
[illegible] Am. B. iii, 1874, 223.
[illegible] f. Orn. Nov. 1854.

[illegible] a bluish slate-color,

darker on the head; the tail brownish, crossed with five bands of blackish-brown, and ending with white; primaries brown; sides of the head and of the neck uniform bright rufous (not of a deep color) and without dark striæ; chin and throat pale rufous-white, unspotted; under plumage white, with narrow transverse bars of pale rufous on the breast; and on the abdomen, sides, and thighs with very faint narrow bars of pale rufous-brown, almost obsolete on the lower parts of the abdomen and thighs; under tail-coverts pure white; bill black, plumbeous at base; legs yellow.

"Length, about 10½ inches; wing, 6¼; tail, 4⅞; tarsus, 1⅞."

Adult female.—"It is larger than the male and more distinctly barred on the breast, the thighs rather lightly so; it has the unspotted rufous cheeks, and the lower part of the abdomen is white, as in the male."

Young male.— . . . "Umber-brown above, with the cheeks of a reddish-brown streaked with dusky; the breast blotched with light brown, and bars of darker brown on the abdomen; lower part of the abdomen white, with faint brown transverse markings."

Young female.— . . . "Pale umber-brown above, the sides of the head and neck having dusky streaks and showing scarcely any coloring of rufous; sagittate blotches on the breast of a pale rufous-brown, with narrow transverse waving lines on the abdomen and thighs of a paler brown."

"Another young female . . . has the sides of the head rufous-brown, with dark streaks, and the throat pale rufous; the markings on the lower parts darker and more clearly defined, the thighs more barred than in any of the others."

Mr. Lawrence remarks (*l. c.* p. 10):—"In form, *fringilloides* is smaller and more slender than *fuscus*, but the clear rufous cheeks, nearly white under plumage, especially that of the thighs, are strongly in contrast with the rufous-brown cheeks streaked with dark brown, and the strongly-marked rufous under plumage and thighs of *fuscus*. All specimens of the young under examination have the markings on their under plumage transverse, on the abdomen and thighs being waving and narrow; whereas in the young of *fuscus* these markings are longitudinal, large in size, and more extensively distributed; on the sides they are heart-shaped in form, and guttate on the abdomen and thighs."

Dr. Gundlach remarks (Lawrence, *l. c.*, p. 11) that "the adult male and female have the bill black, with the base of a lead color; cere and feet yellow, or pale orange; iris reddish-gray The bill in the young is black on the upper part to the extremity, with a bluish base; cere and cheeks yellowish-green; iris pale orange-gray; feet yellow." According to the same gentleman, the fresh measurements were as follows:—*Adult male.*—Length, 0.278; extent, 0.508; tail, 0.135. *Adult female.*—Length, 0.326; extent, 0.618; tail, 0.155.

NISUS ERYTHROCNEMIS.

Falco nisus MAX. Beitr. iii, i, 1830, 111 (not of Linn. 1766.)
Accipiter erythronemia GRAY, List Acc. B. M. 1848, 70.
A. erythronemius BONAP. Consp. i, 1850, 32.—STRICKL. Orn. Syn. i, 1855, 116.
A. erythrocnemis SCL. P. Z. S. 1855, 134; *ib.* 1860, 76; *ib.* 1866, 303.—LEE, Ibis, 1873, 135 (Arg. Rep.; notes).—SCL. & SALV. Ex. Orn. 1867, pl. xvii; Nom. Neotr. 1873, 120.—SHARPE, Cat. Acc. B. M. 1874, 147.
A. erythrocnemius GRAY, Hand List, i, 1869, 32.
Nisus erythrocnemius KAUP, Contr. Orn. 1850, 64.—SCHL. Mus. P.-B. Rev. Acc. 1873, 70.
N. erythronemius RIDGW. Pr. Boston Soc. N. H. May, 1873, 58.
Nisus fringillarius subsp. *erythrocnemius* KAUP, Wiegm. Arch Bd. i, 1850, 34.
Nisus striatus BURM. Th. Bras. ii, 1856, 71.

Hab.—Brazil, Bolivia, and Argentine Republic.

Wing, 6.25–7.40; tail, 5.40–6.20; culmen, 0.35–0.45; tarsus, 1.55–1.90; middle toe, 1.10–1.20. Fourth to fifth quill longest; first shortest; outer five with inner webs emarginated; tail even.

Adult.—Above, slate-color (varying from bluish to brownish), the pileum slightly darker; the scapulars with large rounded concealed spots, and upper tail-coverts with smaller concealed bars of white; tail narrowly tipped with white and crossed by four to five regular, continuous bands of black and slate-gray; the bands and interspaces of about equal width. Tibiæ plain rufous; rest of lower parts white; the crissum immaculate and the throat variegated only by fine dusky shaft-streaks; auriculars and sides strongly tinged with rufous; breast, abdomen, sides, and flanks marked with narrow transverse bars of rusty-brown, grayish-brown, or rufous.

Young.—Above, grayish-brown, the feathers very conspicuously bordered terminally with rusty; tail grayer, crossed by five regular and continuous bands of dull black, nearly equal in width to the gray interspaces (sometimes wider, sometimes narrower). Tibiæ uniform rufous; other under parts white, sometimes tinged with yellowish-ochraceous (especially on the under side of the wings); the sides tinged with rufous; the breast and sides with rusty-brown markings in the form of sagittate spots; crissum immaculate; throat and cheeks ditto, or with merely fine shaft-streaks of blackish.

In the coloration of the upper parts, bright-rufous auriculars, and in the regularity and narrowness of the bars of the lower parts, as well as in their color, the adult female of this species resembles very closely the adult male of *N. fringillarius* of Europe, but differs in smaller size, uniform rufous tibiæ, and more distinctly-banded tail.

List of specimens in United States National Museum.

Catalogue No.	Corresponding No. of—	Original No.	Nature of specimen.	Sex and age.	Locality.	When collected.	From whom received.	Collected by—
59945	....	....	....	♂ juv.	Brazil	.....	Sr. Don F. Albuquerque.	
59945	....	....	....	.....	do	.....	do	
61942	....	....	....	♀ juv.	do	.....	.....	

Other specimens examined.—In Coll. O. Salvin, 3; G. N. Lawrence, 1; Philad. Acad., 3; N. Y. Mus., 1; Mus. Comp. Zool., 1; total, 12.

Measurements.

Catalogue No.	Museum.	Sex and age.	Locality.	Wing.	Tail.	Culmen.	Tarsus.	Middle toe.	Collected by—
7793	M. C. Z	♂ ad.	Pernambuco	6.30	5.60	.....	.....	.....	J. C. Fletcher.
.....	O. S.	♀ ad.	Bahia	7.40	6.20	0.45	1.80	1.20	Wucherer.
.....	O. S.	♂ juv.	Brazil	6.20	6.00	0.35	1.65	1.10	H. Whitely.
.....	O. S.	♀ juv.	Bahia	7.40	6.60	0.45	1.90	.....	Wucherer.

NISUS VENTRALIS.

Accipiter erythrocnemius? Scl. P. Z. S. 1855, 134.—Orton, Am. Nat. 1871, 624 (Quito Valley).

Accipiter ventralis Scl. P. Z. S. 1866, 303.—Scl. & Salv. Ex. Orn. ii, 1867, 25, pl. xiii; *ib.* xi, 170; P. Z. S. 1870, 782, 788 (Venezuela); Nom. Neotr. 1873, 120.—Gray, Hand List, i, 1869, 32.—Sharpe, Cat. Acc. B. M. 1874, 149.

?Accipiter nigro-plumbeus, Lawr. Ann. N. Y. Lyc. 1869, 270 (Quito Valley, Ecuador= *melanism?*).

Hab.—Venezuela, Colombia, and Ecuador.

Wing, 6.30–8.70; tail, 5.40–7.25; culmen, 0.35–0.55; tarsus, 1.65–2.20; middle toe, 1.10–1.50. Fourth and fifth quills longest; first shortest; outer five with inner webs sinuated. Tail even, or very slightly rounded. Tibiæ uniform deep rufous. Tail dull black, crossed by four narrow continuous bands of slate-gray or brownish-gray, and narrowly tipped with grayish or white. *Adult.*—Above, uniform dark plumbeous except the tail, the scapulars and upper tail-coverts with concealed white spots. Beneath, chiefly rufous, sometimes entirely so, but usually whitish in the crissum and throat, and often broken along the middle line by an indistinct transverse white spotting. *Young.*—Above, dark sepia, the feathers with rusty terminal borders. Lower parts (except tibiæ) white, marked with large, rather longitudinal, sagittate spots of umber.

Sexes alike in color, but differing in size as follows:—

Males:—Wing, 6.60–6.95; tail, 5.70–6.20; culmen, 0.40–0.45; tarsus, 1.90–2.10; middle toe, 1.25–1.30. (Six specimens.)

Females:—Wing, 7.75–8.00; tail, 6.80–7.00; culmen, 0.50–0.55; tarsus, 2.15–2.20; middle toe, 1.40–1.50. (Four specimens.)

There is greater variation in the plumage of this species than in any of its allies, and, contrary to the usual rule, the adults vary more than the young. The darkest example of the latter we have seen is an adult male from Ecuador in Mr. Salvin's collection. In this specimen, every portion of the lower parts is rufous, even the throat, crissum, and lining of the wing being of this color, while the tibiæ and abdomen are so dark and purplish as to border on a chestnut shade. The flanks show narrow, transverse, indistinctly-defined bars of white. An adult male from the interior of New Granada is quite a contrast to this, and represents the light extreme. In this example, the breast is nearly uniform light gray and rufous, the former predominating, while the sides, abdomen, and flanks are barred with white, gray, and rufous, in broad, ragged, not well-defined bars, of which the white ones average the widest, while the rufous and gray are mixed in nearly equal proportion. The crissum and throat are pure white, the latter with dusky shaft-streaks; the lateral feathers of the former with a faint mottling of grayish. An adult male from Venezuela (Merida) has the flanks uniform deep rufous, like the tibiæ; the breast, belly, and sides being light grayish-fulvous, becoming lighter toward the jugulum; the feathers marked with darker grayish bars concealed beneath the surface. Other specimens are variously intermediate between these, there being usually more or less of an indistinct barring of white and grayish along the median line of the abdomen and breast. The young birds vary considerably also, especially in the markings of the lower parts. In the males, these are usually longitudinal on the breast; but in the two females before us, each of these markings spreads anteriorly, so as to form a spot of a widely sagittate form.

Besides the variations noted above, the *N. nigroplumbeus* (Lawrence) may represent a melanism of the adult plumage in this species, since,

except in the uniform dark plumbeous of the lower parts it is exactly like dark Ecuador examples of *N. ventralis*, while the type of the supposed species is from the Quito Valley. In his recent work on the Owls,* Mr. Sharpe mentions (on p. 23) a specimen of *Bubo*, supposed to be *B. virginianus*, in the Salvin-Godman collection, from Ecuador, "which is so black as to suggest the possibility of its being a case of melanism". Should this remarkable bird prove to be indeed a melanism of either *B. virginianus* or *B. magellanicus*, the case will be a unique one in this family, so far as we know; and allowing the probability of this proving to be really its character, it is reasonable to suspect a similar exceptional case in the bird under consideration.

List of specimens in United States National Museum.

Catalogue No.	Corresponding No. of—	Original No.	Nature of specimen.	Sex and age.	Locality.	When collected.	From whom received.	Collected by—
67344	....	....	S.	♀ ad.	Ecuador	.....	G. B. Goode	
61942	....	....	M.	♀ juv.	"South America"	.....	.....	

Other specimens examined.—Mus. O. Salvin, 8; G. N. Lawrence, 2; Philad. Acad., 6; total number examined, 18.

Measurements.

Museum No.	Museum.	Sex and age.	Locality.	Wing.	Tail.	Culmen.	Tarsus.	Middle toe.	Collected by—
	O. S.	♂ ad.	Venezuela (Merida)	6.80	5.80	0.40	1.90	1.25	Goering.
	..do	♂ ad.	Ecuador	6.75	6.00	0.40	1.90	.....	Higgins.
	..do	♂ ad.	New Granada	6.80	6.00	0.45	.....	.....	(Verreaux.)
	..do	♂ ad.	New Granada (interior) ..	6.95	5.70	0.40	2.00	1.25	Trübner.
	..do	♂ juv.	Ecuador (near Quito)	6.60	6.00	0.40	1.95	1.30	Higgins.
	..do	♀ ad.	New Granada (interior)..	8.00	7.00	0.50	.....	1.40	Trübner.
67344	U. S	♀ ad.	Ecuador	7.80	7.00	0.50	2.15	1.45	
61942	..do	♀ juv.	"South America"	7.80	6.80	0.50	2.20	1.50	
	O. S.	♀ juv.	Colombia (Antioquia) ...	7.75	6.90	0.53	2.15	1.50	T. K. Salmon.
	..do	♂ juv.	.....do	6.80	6.20	0.42	2.10	1.30	Do.

NISUS SALVINI.

Nisus salvini, RIDGW. sp. nov.

Wing, 7.60–7.80; tail, 6.90–7.00; culmen, 0.50; tarsus, 2.15–2.20; middle toe, 1.45–1.50. Fourth and fifth quills longest; first shortest; outer five with inner webs emarginated. Tail nearly even or very slightly rounded (♀).

Adult (female?).—Above, including the auriculars, uniform plumbeous, the scapulars and upper tail-coverts with concealed white spots; tail black, narrowly tipped with pale gray, and crossed by four narrow bands of light brownish-gray. Tibiæ uniform cinnamon-rufous; rest of lower parts white; the feathers with dark-brown shafts, except on the crissum. Wing, 7.60; tail, 6.90. (Coll. O. Salvin.)

Young (female?).—Above, dark sepia; the feathers with distinct terminal borders of rusty. Tail narrowly tipped with white, and crossed

* Catalogue of the Striges, or Nocturnal Birds of Prey, in the Collection of the British Museum. By R. Bowdler Sharpe. London: 1875.

by six bands of dull black, wider than the brownish-gray interspaces. Lower parts as in the adult, but feathers of the breast and sides marked with narrow stripes of dilute brown. Wing, 7.80; tail, 7.00. (Merida, Venezuela, 1873. A. Gœring; coll. O. Salvin.)

At first sight, this new species appears very similar to *N. chionogaster*, especially in the whiteness of the lower parts. A close examination reveals so many important points of difference, however, entirely outside the range of variation in that species, that it seems clearly distinct. Indeed, we consider it more closely related to *N. ventralis*, with which it closely agrees in the color of the tibiæ, the narrowness of the light bands on the tail, and in the general aspect of the upper parts. The chief differences from *N. chionogaster* consist in the deep rufous instead of ochraceous tibiæ, dusky instead of white auriculars, and much narrower gray bands on the tail, in which respects it agrees with *N. ventralis*; while from the latter it differs in the pure white lower parts of both old and young.

?NISUS NIGROPLUMBEUS.

Accipiter nigro-plumbeus LAWR. Ann. N. Y. Lyc. 1869, 270 (Quito Valley, Ecuador).—ORTON, Am. Nat. iv, Feb. 1871, 711.

SP. CH.—*Adult male*:—Wing, 6.75; tail, 6.30; culmen, 0.45; tarsus, 1.95; middle toe, 1.30. Fourth quill longest; fifth scarcely shorter; first shortest; outer five with inner webs sinuated. Tail very slightly rounded, almost even. Prevailing color uniform dark plumbeous, the lower surface somewhat more glaucous and mixed on the abdomen, anal region, and crissum with ferrugineous-rufous; this continuous on the middle of the abdomen and in cloudings on the center of the feathers, and paler in tint on the crissum. Tail narrowly tipped with white and crossed by four bands of black, rather broader than the plumbeous ones, which incline to a slaty-brownish tint. Longer scapulars and tertials showing concealed large roundish spots of pure white; occipital feathers snowy-white beneath the surface; upper tail-coverts with concealed bands of ashy, growing white at the base of the feathers. Lining of the wing about equally clouded with light cinnamon and bluish-plumbeous; inner webs of primaries pure white for basal half and hoary slate for terminal half, the white portion crossed by broad bands of blackish slate, which become gradually obsolete in the slaty portion. Tarsal scutellæ fused into a continuous plate. "Iris orange-yellow; tarsi and toes yellow."

Hab.—"Eastern side of Quito Valley, on slope of Antisona, altitude 10,000 to 12,000 feet."

The general appearance of this bird strongly suggests the possibility of its being a melanism of *N. ventralis*. The markings of the tail are the same, and the picturæ of the under surface of the wing is similar, only darker. The color of the upper parts in their entirety differs solely in being of a darker shade; while in the size, and in the details of structure, it corresponds exactly with the male of *ventralis*.

NISUS CHIONOGASTER.

Nisus chionogaster KAUP, P. Z. S. 1851, 41 (Guatemala).
Accipiter chionogaster BONAP. Rev. et Mag. Zool. 1854, 538.—SCL. & SALV. Ex. Orn. ii, 1867, 27, pl. xiv; xi, 170; Nom. Neotr. 1873, 120.—GRAY, Hand List, i. 1869, 32.—SHARPE, Cat. Acc. B. M. 1874, 148.
Accipiter erythrocnemius SCL. & SALV. Ibis, 1859, 218.—SALV. Ibis, 1861, 140.

Hab.—Guatemala.

Wing, 6.80–8.40; tail, 6.00–7.30; culmen, 0.40–0.52; tarsus, 1.90–2.25;

middle toe, 1.30–1.55. Five outer primaries with inner webs emarginated; fourth and fifth quills longest; third next; first shortest. Tail even or very slightly rounded. Lower parts mostly white, without transverse bars, the tibiæ pale ochraceous.

Adult male (specimen in Coll. O. Salvin, from Trinidad or Venezuela):—Above, blackish plumbeous, the pileum darkest; longer upper tail-coverts very narrowly tipped with white. Tail light brownish-slate, narrowly tipped with white, and crossed by four broad bands of dull black. These bands, except the subterminal one, rather narrower than the interspaces. Lower parts pure white; the feathers of the throat, cheeks, and breast with fine shaft-streaks of black; tibiæ plain pale reddish-ochraceous and lining of wing tinged with the same. Inner webs of primaries white, gradually becoming slate-color terminally, and marked with distinct transverse spots of darker slate, these spots or bars being six in number (counting the distinct ones) on the fourth quill. Lores whitish, with black shafts to the feathers; suborbital region and upper and posterior border of the auriculars plumbeous-black. Occipital feathers pure white beneath surface; scapulars with large concealed spots of white. Wing, 6.80; tail, 6.00; culmen, 0.40; tarsus, 1.90; middle toe, 1.25.

Adult female:—Above slate-color, with a brownish cast; tail light-brownish slate (sometimes with a narrow white tip), crossed by four or five broad bands of dull black. Lower parts as in the male. Wing, 7.85–8.40; tail, 6.60–7.30; culmen, 0.50–0.52; tarsus, 2.10–2.25; middle toe, 1.50–1.55.

Young (*both sexes*):—Above, dark slate-brown (the pileum nearly black), each feather indistinctly bordered terminally with pale fulvous. Tail light grayish-brown, crossed by four broad bands of dull black. Lower parts as in the adult, but feathers of the breast and sides with faint longitudinal stripes of dilute brown, these wider and more rufous on the sides.

Among the adult females before us, four in number, there is but slight variation to be noticed, three of them being quite alike, while the remaining one, a specimen from San Geronimó, Vera Paz, Guatemala (No. 2272, Mus. Salv. and Godm.), differs in having the lower parts quite extensively tinged with ochraceous, especially on the breast and sides, while the anterior portions are destitute of the usual dusky shaft-streaks.

List and measurements of specimens examined.

Locality.	Sex and age.	Wing.	Tail.	Culmen.	Tarsus.	Middle toe.	Remarks.
a. "Trinidad or Venezuela"[??]	♂ ad.	6.80	6.00	0.40	1.90	1.35	August 22, 1873.
b. Guatemala (Medio Monte)	♂ juv.	7.00	6.10	0.42	2.00	1.30	
c. Guatemala (Vera Paz)	♀ ad.	8.20	7.00	0.50	2.20	1.50	Lauquin; Mar., 1860; No. 2274.
d. Guatemala (Sayana Grande)	♀ ad.	8.15	6.80	0.52	2.15	1.50	Pacific side; No. 2273.
e. Guatemala (Vera Paz)	♀ ad.	8.00	6.60	0.52	2.10	.....	San Geronimó; July, 1862; No. 2272.
f. Guatemala (Vera Paz)	♀ ad.	7.85	6.90	0.50	2.20	1.55	Choctun; Jan., 1860; No. 2275.
g. Guatemala (Volcan de Fuego)	♀ juv.	8.40	7.30	0.50	2.25	1.50	Aug., 1873; altitude, 8,000 feet.

SUBGENUS HIERASPIZIAS, KAUP?

Hieraspiza KAUP, Class. Säug. u. Vög. 1844, 116. Type, *Falco tinus* LINN.?
"*Jeraspiza* KAUP, 1851" (*fide* Gray).
Teraspiza KAUP, Proc. Zoöl. Soc. Lond. 1867, 171. Same type?

CHARACTERS.—Four outer primaries with inner webs emarginated; third or fourth quill longest. End of inner toe reaching to or beyond middle of second joint of middle toe.

In the last paper cited above, Kaup includes in his genus "*Teraspiza*" a single American species, *Falco tinus* Linn., and two Old World species, *Falco virgatus* Temm. and *Accipiter rhodogaster* Gurney (*ex* Schlegel). The first of these is probably the type, or, at least, was considered typical, since it was the one selected for illustration of the generic characters. This is the only species of those named at present before us, so we cannot state positively whether the other two are sufficiently similar in the details of form to be properly included in the same subgenus. This is also the case with *Accipiter collaris* Sclater; for, although we have examined a specimen in the museum of the Philadelphia Academy, we are not prepared to say that it is strictly congeneric with *A. tinus*, although according to our recollection it is extremely similar in the details of form and in relative proportions. Regarding these species, Mr. Gurney (Ibis, 1875, pp. 470–472) speaks as follows:—"*A. collaris* is . . . . . remarkable in the robust character of its tarsi and feet, and is perhaps not properly referable to any of the subgeneric forms into which the genus *Accipiter*, as used by Mr. Sharpe, may be considered to be divisible, being, in fact, very much *sui generis*. . . . . Notwithstanding the great resemblance in the character of the coloration which exists between *A. collaris* and *A. tinus* in their first dress, and, to a certain extent, in their adult plumage also, I am disposed to assign *A. tinus* to a group distinct from *A. collaris;* and in this group I would also include three small African hawks, *A. hartlaubi*, *A. minullus*, and *A. erythropus*. . . . . The late Dr. Kaup associated *A. tinus* and *A. minullus* in a distinct subgenus, first under the title *Hieraspiza* and subsequently under that of *Teraspiza*, with *A. virgatus* and *A. rhodogaster;* but I am disposed to consider that the two latter species belong rather to the group of which *A. nisus* is the type, though they are in some respects aberrant members of it." Pending the decision of this question, we include the *N. collaris* provisionally in the subgenus *Hieraspizias*, along with *N. tinus*.

The two American species agree in the following—

COMMON CHARACTERS.—Above plain plumbeous (*adult*), sepia-brown or rusty-rufous (young), the pileum abruptly darker. Tail plumbeous, crossed with four to five bands of blackish, about equal in width to the interspaces (*adult*) or brown or bright rufous with six to seven narrow bands of dusky (*young*). Beneath white, with very regular bars of plumbeous (*adult*), or ochraceous, with similar bars of brown or rusty (*young*). They may be distinguished by the following diagnoses:—

1. H. TINUS.—Wing, 5.20–6.50; tail, 3.90–5.50; culmen, 0.45–0.55; tarsus, 1.40–1.90; middle toe, 1.00–1.35. No whitish or ochraceous nuchal collar. *Hab.*—Brazil to Guatemala.

2. H. COLLARIS.—Wing, 6.75–7.00; tail, 5.00–5.50; culmen, 0.55; tarsus, 1.75–2.00; middle toe, 1.28. A nuchal collar of white or ochraceous the feathers dusky-tipped. *Hab.*—New Granada..

NISUS (? HIERASPIZIAS) SUPERCILIOSUS ?

?? *Falco superciliosus* LINN. S. N. i, 1766, 128 (Surinam), (=*juv.*, transition-plumage?).—GMEL. S. N. i, 1788, 282.—LATH. Ind. Orn. i, 1790, 45; Gen. Hist. i, 1821, 294.
Accipiter superciliosus STRICKL. Orn. Syn. i, 1855, 115.
??? *Falco tinus* LATH. Ind. Orn. i, 1790, 50; Gen. Hist. i, 1821, 295 (Cayenne).—DAUD. Tr. Orn. ii, 1800, 146.—SHAW, Zoöl. vii, 1812, 209.
Accipiter tinus, GRAY, List Acc. Br. Mus. 1848, 72; Gen. B. 1849, 29, pl. 10 (adult); Hand List, i, 1869, 33.—SALVIN, P. Z. S. 1867, 158 (remarks on coloration).—BONAP. Consp. i, 1850, 32.—PELZ. Orn. Bras. 1871, 8, 399.—SCL. & SALV. Nom. Neotr. 1873, 120.—SHARPE, Cat. Acc. Br. Mus. 1874, 139.
Hieraspizia tinus KAUP, Contr. Orn. 1850, 63.
Ieraspiza tinus BONAP. Rev. et Mag. Zool. 1854, 538.
Nisus tinus BURM. Th. Bras. ii, 1855, 70.—SCL. Mus. P.-B. Astures, 1862, 33; Rev. Acc. 1873, 77.—RIDGW. Pr. Boston Soc. May, N. H. 1873, 59.
Teraspiza tinus KAUP, P. Z. S. 1867, 171.
Sparvius subniger VIEILL. Nouv. Dict. 1817, 319.—PUCHERAN, Rev. Zool. 1850, 92.
Sparvius minutus VIEILL. N. D. x, 1817, 328, Enc. Méth. iii, 1823, 1267.—PUCHER. R. Z. 1850, 93.
Nisus malfini LESS. Tr. 1831, 58.—PUCHER. R. Z. 1850, 209.
Ieraspiza fontanieri BONAP. Rev. et Mag. de Zool. 1854, 538.

Hab.—Brazil to Guatemala.

Wing, 5.20–6.50; tail, 3.90–5.50; culmen, 0.45–0.55; tarsus, 1.40–1.90; middle toe, 1.00–1.35. Third or fourth quill longest; first shortest; inner web of outer four distinctly emarginated. Lower parts, except throat (and sometimes the anal region), with distinct transverse bars of rufous, brown, or plumbeous, on an ochraceous or white ground.

Adult.—Above dusky, the pileum nearly black, and the back with a decided plumbeous cast. Tail with four to five bands of blackish and plumbeous or brownish-slate (the two colors in nearly equal proportion,) and sometimes with a narrow terminal margin of white. Ear-coverts and sides of nape plumbeous, the former usually somewhat broken by a faint, whitish, indistinct barring. Lower parts white, the entire surface covered with numerous, regular, transverse bars of light slate or plumbeous, these bars usually wider on the sides than along the median portion, widest apart on the crissum, and most numerous and dense on the tibiæ; axillars and lining of the wing similarly barred. Inner webs of primaries with transverse spots of dusky slate from base to end. Gular region white, without bars.

Young.—Brown phase:—Above, sepia-brown, the pileum nearly black; the feathers with or without rusty borders. Tail lighter, and crossed by six to seven bands of dusky black. Lower parts white or pale ochraceous, barred as in the adult, but with rusty-brown or umber, instead of slate or plumbeous. *Rufous phase:*—Above, bright rusty-rufous, brightest on the tail, more dusky on the pileum. Tail with six to seven narrow bands of black, these sometimes not reaching from the shaft to the edge of the feathers. Lower parts pale ochraceous or rufescent white (the tibiæ quite rusty), barred as in other stages, but with deep rufous or rusty-brown.

That the rufous plumage of this species is not a progressive stage, but a mere individual phase, is proven by the examination of individuals in the transition-state. One of this character in Mr. Salvin's collection, from Veragua, originally an extreme example of the rufescent phase, was moulting directly into the adult plumage described above, as numerous new feathers in all parts of its plumage plainly show. Another, in the same collection, from Bahia, is an adult in somewhat worn plumage, still retaining a few bright-rufous feathers among the axillars. On the other hand, specimens which are in the sepia-brown plumage, usually regarded as an intermediate stage between the rufous

and plumbeous plumages, show rusty borders to the feathers of the upper parts, while besides the texture of their plumage leaves no doubt that they are very young birds in their first dress.

Both adult and young exhibit the usual individual variation; the former varying in the greater or less bluish cast to the back and the bars underneath, the degree of blackness in the color of the pileum, and the former exhibiting tints variously intermediate between the rufous and brown phases. There appears to be no well-marked sexual difference in plumage at any age, though the adult males seem to be rather more plumbeous than the females.

The proper specific name for this species is involved in considerable doubt. Strickland is, we believe, the only one who has identified it with the *Falco superciliosus* of Linnæus; other authors having, for some reason, we know not what, discarded this name, and taken that of *Falco tinus* Latham, as the first designation of the species. So far as the original descriptions are concerned, both of those quoted are extremely inaccurate, and disagree in very important respects with the characters of the bird under consideration; but if there is no other clue to what species were meant by these authors than their diagnoses, Latham's description is much more inapplicable than that of Linnæus. It is as follows, the points of disagreement being italicized:—

"F. pedibus flavis, corpore cinereo-fusco, subtus albido fasciis nigricantibus, *vertice albido.* Tiny Falcon, Lath. Synop. sup. p. 39. Habitat in Cayana; inter minimos numerandus; ab apice rostri ad basin caudæ uncias sex tantum implens."

This is at best a very poor diagnosis of the species under consideration; since, if this were the bird described, it is difficult to see why a bird which invariably has a uniform black or dusky vertex should have this portion described as white!

Linnæus describes his *F. superciliosus* as follows:—

"F. cera pedibus palpebrisque luteis, corpore fusco albido undulato, remigibus ferrugineis nigrofasciatus. Habitat in Surinamo. Dahlberg. Magnitudo Picæ. Corpus supra fuscum, subtus totum etiam femoribus confertim nigro undulatum. Remiges ferrugineæ fasciis nigris pluribus; sed secundariæ margine posteriore albido. Cauda nigra fasciis duabus latis & apice cinereis. Crissum album, strigis aliquot nigris. *Uropygium albo nigroque varium.* Supercilia subtus nuda, prominula. Lora setis nigris patentibus. Rostrum & ungues nigri. Tectrices alarum inferiores albæ lineolis tenuissimis nigris."

This description is, in the main, a sufficiently accurate diagnosis of the present species in the transition-stage, or in moulting from the ferruginous plumage, which sometimes characterizes the young, into the adult plumbeous stage, remnants of the first dress being the ferruginous remiges, as described. But the clause "rump varied with black and white" is manifestly not a character of the present species, in which this part is uniform slaty, with, however, an indistinct white spotting beneath the surface, to be seen only upon disturbing the feathers. But this discrepancy is trifling compared with that in Latham's description of his *Falco tinus*, and, unless there is a better reason than we know of, we cannot see why Linnæus' name *superciliosus* should not be preferred.

In case both these names be rejected on account of the reasons stated, *Sparvius subniger* Vieillot would be unobjectionable, since the type has been fully identified with this species by Pucheran.

Measurements.

Museum.	Sex and age.	Locality.	Wing.	Tail.	Culmen.	Tarsus.	Middle toe.	Collected by—
R. R	♂ ? ad.	Demerara	5.70	4.50	0.45	1.60	1.10	
O. S.	♀ ? ad.	Bahia	6.30	4.90	0.50	1.90	1.30	Wucherer.
Do.	♂ ? ad.	do	5.50	4.10	0.45	1.55	.....	Do.
Do.	♂ ? ad.	Venezuela (San Estaban)	6.50	4.80	0.50	1.80	1.30	Gœring.
Do.	♂ juv.	New Granada	5.40	4.20	0.45	1.50	1.10	(Verreaux.)
Do.	♀ juv.	Veragua (Santiago)	6.10	4.90	0.50	1.80	1.25	E. Arce.
Do.	♀ juv.	Rio Janeiro	6.10	5.30	0.50	1.90	1.35	
Do.	♀ juv.	do	6.35	5.50	0.52	1.85	1.35	

List of specimens examined.—In Mus. O. Salvin, 7; G. N. Lawrence, 2 (*Panama*); Philad. Acad., 3 (*Cayenne*); Boston Soc., 2 (*Brazil, Venezuela, Cayenne*); American Mus., New York, 3; R. Ridgway, 1 (*Demerara*); total, 18.

NISUS (?HIERASPIZIAS) COLLARIS.

Micronisus collaris KAUP, MS. in Mus. Brit., undè—

Accipiter collaris SCL. Ibis, ii, 1860, 148, pl. vi (adult and young).—LAWRENCE, Ann. Lyc. N. Y. 1862, 8 (New Granada).—GRAY, Hand List, i, 1869, 33.—SCL. & SALV. Nom. Neotr. 1873, 120.—SHARPE, Cat. Acc. B. M. 1874, 144.—SALV. Ibis, iv, 1874, 321.

Nisus collaris GIEBEL, Thes. Orn. 1872, 263.

Hab.—New Granada.

SP. CH.—Wing, 6.75–7.00; tail, 5.00–5.50; culmen, 0.55; tarsus, 1.75–2.00; middle toe, 1.28. Fourth quill longest; first shortest; outer four with inner webs sinuated. Tail even. *Adult (?):*—Above dark vandyke-brown, becoming blackish on the pileum; a nuchal collar of white, with the tips of the feathers dusky. Tail brownish-slate, crossed by five bands of black, about equal in width to the slaty bands. Lower parts white, marked everywhere, except on throat, with very regular, sharply-defined broad bars of vandyke-brown, averaging nearly or quite as wide as the white interspaces. *Young:*—The dark brown of the adult (?) replaced by ferruginous, this brightest on the tail, which has six instead of five black bands. Lower parts "cinnamomeous-white", the tibiæ more rusty, the sides barred, as in the adult. (*Fidè* Sclater, Ibis, 1860, p. 149.)

We are not satisfied as to whether the above description of the supposed adult is really the mature stage or the brown phase of the young. Our description is taken from the specimen in the museum of the Philadelphia Academy of Natural Sciences, which came from Bogota.

APPENDIX.

Regarding *Falco poliogaster* Temminck and *Astur pectoralis* Bonaparte, mentioned on page 91, we have, as yet, seen no specimens. We strongly incline to the belief that they will be found different from the true *Nisi*, and each sufficiently peculiar in details of form to constitute a subgenus by itself.

Regarding *F. poliogaster*, Mr. Gurney writes us that it is more like *Leucopternis* in its generic characters than typical *Nisus;* and we regard the remarkable coloration of *A. pectoralis* is a sufficient cause for suspecting the impropriety of referring the latter species to either section of the genus *Nisus* as defined in our monograph. (See Sclater, Ibis, 1861, pp. 313–314, pl. x).

The synonymy and specific characters of these two aberrant species are as follows:—

NISUS (?) POLIOGASTER.

Falco poliogaster TEMM. Pl. Col. i, 1824, pl. 264 (ex Natterer M. S.).
Astur poliogaster VIG. Zoöl. Journ. i, 1824, 338.—STEPH. Zoöl. xiii, pt. 2, 1826, 29.—LESS. Man. i, 1831, 93.—CUV. Règ. An. ed. 2, i, 1829, 332.—GRAY, Gen. B. i, 1849, 27.—STRICKL. Orn. Syn. i, 1855, 121.—SHARPE, Cat. Acc. B. M. 1874, 120.
Nisus poliogaster LESS. Tr. 1831, 62.—SCHL. Mus. P.-B. Astures, 1862, 43; Rev. Acc. 1873, 96.
Asturina poliogastra KAUP, Isis, 1847, 198; Contr. Orn. 1850, 67.—BONAP. Consp. i, 1850, 30.
Cooperastur poliogaster BONAP. Rev. et Mag. Zool. 1854, 538.
Accipiter poliogaster GRAY, Hand List, i, 1869, 33.—PELZ. Orn. Bras. 1871, 8.

Hab.—Brazil.

"*Adult male* (type of species): Above dark leaden grey, the ear-coverts and sides of the neck uniform with the crown, which is slightly darker than the back, as also are the wing-coverts; upper tail-coverts tipped with clear ashy-grey; quills brown, with rufous brown shafts, the secondaries leaden grey like the back; the quills barred with darker brown, these bars showing more plainly underneath, where the lower surface of the wing is ashy white, inclining to pure white near the base of inner web; tail black, tipped with whitish and crossed with three narrow bars of clear ashy grey, a little rufescent near the shafts; entire under surface, including the under tail-currents, pale grey, the throat and under wing-coverts whiter, the shafts darker, showing a hair-like stripe. Total length 17 inches, culmen 0.85, wing 9.8, tail 7.8, tarsus 2.15, middle toe 1.4. (*Mus. Lugd.*)"—(SHARPE, *l. c.*)

Regarding this very rare species, of which we have seen no examples, Mr. Gurney writes me as follows:—"This species, which Schlegel calls a '*Nisus*,' and Gray a '*Cooperastur*', seemed to me, when I examined it at Leyden in 1869, to be a *Leucopternis*. At first sight its appearance is a good deal like *Micrastur mirandollei*,* but from that species it is evidently generically distinct. The type-specimen at Leyden is the only one I have seen. The bird figured by Temminck as the young of this species is said by Schlegel to be the young of *Cooperastur pileatus*." (*Vide* Mus. Pays-Bas, Astures, p. 43.)†

NISUS (?) PECTORALIS.

Astur pectoralis BONAP. Rev. et Mag. Zool. 1850, 490.—SCHL. Mus. P.-B. Astures, 1862, 18.—PELZ. Orn. Bras. 1871, 6, 398; Rev. Acc. 1873, 63.—SHARPE, Cat. Acc. B. M. 1874, 121.
Cooperastur pectoralis BONAP. Rev. et Mag. Zool. 1854, 538.
Accipiter pectoralis SCL. Ibis, iii, 1861, 313, pl. x; Ibis, iv, 1862, 194.—GRAY, Hand List, i, 1869, 33.—SCL. & SALV. Ex. Orn. xi, 1869, 170; Nom. Neotr. 1873, 120.—SALVIN, Ibis, 1874, 321 (Specimen in Mus. Philad. Acad).

Hab.—Brazil (Ypenema and Borba; NATTERER).

"*Female, not quite adult.*—Above brown, with tips of rather paler brown to the feathers of the middle back, scapulars, and secondaries; the greater part of the wing-coverts, the interscapular region, and the lower back, rump, and upper tail-coverts black, with white tips; crown of head crested, pure black; ear-coverts and sides of neck rich rufous, forming a broad collar round the back of the latter; feathers below the eye and a faintly-indicated moustachial streak black; throat white, a

* This resemblance is so very close that we have seen specimens of the *Micrastur* labeled "*M. poliogaster* Temm."

† Notwithstanding Professor Schlegel's conclusion, we judge from Temminck's plate that the bird figured is really the young of *N. poliogaster*, since it agrees with this species in its stout form, and presents conspicuous points of difference both in form and coloration from the young of *N. pileatus*.

central streak and a few feathers on the lower part black; fore neck and chest rufous, like the hind neck, the center varied with black and white; rest of under surface white, with very broad and distinct bars of jet-black on the flanks and thighs, smaller and less distinct in the center of the body; under wing-coverts and axillaries white like the breast, and similarly barred with black; quills brown, barred above with darker brown, the under surface ashy white, with a few greyish-black cross-bars; tail ashy brown, with four broad black bars, equally distinct on the under surface, which is ashy white; bill horn-brown, yellowish at base; feet yellow. Total length 19 inches, culmen 1.3, wing 11, tail, 8.5, tarsus 2.4. (*Mus. Lugd.*)"—(SHARPE, *l. c.*)

According to Sclater (Ibis iv, 1862, p. 194), the iris is dirty gamboge-yellow; ring round eye and lores dark yellow, verging toward olive-green; superciliary shield olive-green; cere grayish-green; bill grayish-blue and black; tarsi and toes dirty gamboge-yellow; claws black. (*Fide* PELZELN.)

Mr. Gurney gives some very interesting notes on this species in the Ibis, vol. v, 1875, pp. 356–7, which we reproduce here:—"As the Leyden specimen, of which the measurements are given by Mr. Sharpe, and that at Antwerp, of which the dimensions were recorded by Dr. Sclater in 'The Ibis' for 1861, appear by their size to be both female birds, I add the following particulars of the supposed male which is preserved in Norwich:—wing from carpal joint 9.1 inches; tarsus 2.1; middle toe, s. u. 1.3; culmen from anterior margin of cere 5. It will be seen by these measurements of the culmen and middle toe, that, according to the rule given by Mr. Sharpe at p. 47 of his 'Catalogue,' this species comes rather under his genus *Accipiter* than under that of *Astur*; its natural position appears to me to be intermediate between the Asturine subgenus *Lophospizias* and the Accipitrine subgenus *Cooperastur*, to which it was referred (and, on the whole, I think rightly) by Bonaparte in the Rev. et Mag. de Zool. for 1854, p. 538."

GENUS GERANOAËTUS, KAUP

Geranoaëtus KAUP, Class. Säug. Vög. 1844, 122. Type, *Spizaëtus melanoleucus* VIEILL.
Geranaëtus AGASS.
Heteroaëtus KAUP, 1845.—Contr. Orn. 1850, 74.—SUND. Disp. Acc. Hemeroharp. 1874, 27.
Heteraëtus KAUP, Isis, 1847 (*fide* Sundevall).—REICHENB. 1850.

CH.—Form intermediate between that of *Buteo* and *Haliaëtus*. Wings very long, the primaries rigid, and tail very short and graduated. Bill much as in *Haliaëtus*, the culmen being arched above the horizontal, but slightly convex, upper outline of the cere, the superior tomium doubly sinuated, and the tip well produced and sharp. Nostril obliquely horizontal. Feet typically buteonine; tarsus, about one and a fourth times the middle toe; outer toe much longer than the inner; posterior toe much shorter than the inner. Tarsus with the anterior and posterior series of transverse scutellæ very continuous and perfect; web between the outer and middle toes well developed. Wing large and pointed; third or fourth quill longest; first shorter than seventh; outer five with their inner webs deeply emarginated. Tail less than half the wing, graduated, the feathers very rigid. Feathers of the head and neck cuneate, approaching lanceolate; tibial plumes well developed; secondaries, 17.

Somewhat intermediate between *Buteo* and *Haliaëtus*, this genus is nevertheless very distinct from either. It is, perhaps, most like the latter, with which it agrees in short, graduated tail, with rigid feathers, deep emargination of the five outer primaries, general form of the bill, and lanceolate form of the feathers of the head and neck. The feet, however, are much more like those of *Buteo*, there being a well-developed web between the outer and middle toes, of which not a trace is seen in *Haliaëtus*, while the scutellation is also that of the typical *Buteones*.

But one species is at present known.

GERANOAËTUS MELANOLEUCUS.

Spizaëtus melanoleucus VEILL. N. D. xxxii, 1819, 57.
Haliaëtus melanoleucus D'ORB. & LAFR. Syn. Av. 1838, 3.—D'ORB. Voy. Am. Mérid. Ois. 1847, 76.—BURM. Th. Bras. ii, 1855, 54.—GRAY, Hand List, i, 1869, 17.
Pontoaëtus melanoleucus GRAY, Gen. i, 1845, 18.
Cuncuma melanoleucus GRAY, List Acc. B. M. 1848, 25.
Geranoaëtus melanoleucus STRICKL. Orn. Syn. i, 1855, 55.—BURM. Reise La Plata St. ii, 1861, 425.—PELZ. Orn. Nov. 1865, 7 (Chile); Orn. Bras. 1871, 49, 397.—ORTON, Am. Nat. 1871, 624 (Quito Valley).—HUDSON, P. Z. S. 1872, 534 (Rio Negro, Patag.).—LEE, Ibis, 1873, 131, 136 (Arg. Rep.).—SCL. & SALV. Ibis, 1869, 284 (Cape Negro, Str. Magellan, Nov. 29); P. Z. S. 1869, 155 (Tungasuca, Peru); Nom. Neotr. 1873, 119.—RIGW. Pr. Boston Soc. N. H. May, 1873, 68.—SCL. & SALV. Nom. Neotr. 1873, 119.
Asturina melanoleuca SCHL. Mus. P.-B. Asturinæ, 1862, 5; Rev. Acc. 1873, 102.
Buteo melanoleucus SHARPE, Cat. Acc. B. M. 1874, 168.
Spizaëtus fuscescens VIEILL. N. D. xxxii, 1819, 55.
Falco aguia TEMM. Pl. Col. i, 1824, pl. 302.
Haliaëtus aguia CUV. Règ. An. i, 1829, 327.—LESS. Tr. 1831, 42.
Geranoaëtus aguia KAUP, Contr. Orn. 1850, 74.—BONAP. Consp. i, 1850, 15.
Buteo aguia CABAN. & TSCHUDI, Arch. f. Naturg. 1844, 264; Fauna Per. 1844, 89.—SUND. Av. Tent. 1873, 107.
Heteroaëtus aguia KAUP, Contr. Orn. 1850, 74.
Aquila obscura y blanca AZARA, Pax. Par. i, 1802, 61.
Aquila parda AZARA, *l. c.* 65.

Hab.—Mountainous districts of Western and Southern South America, from Patagonia northward to New Granada and Southern Brazil.

Wing, 18.25–23.70; tail, 8.70–13.00; culmen, 1.20–1.60; tarsus, 3.25–4.30; middle toe, 2.40–3.30. *Adult:*—General color deep black, the lower parts posterior to the breast (including lining of the wing) pure white, and the lesser and middle wing-coverts ash-gray; the white and ashy portions narrowly and closely barred with dusky slate or blackish; chin, throat, and cheeks pale grayish with black shaft-streaks; feathers of the neck and breast, also the upper tail-coverts and the rectrices, sometimes minutely tipped with white or grayish. *Young:*—Above chiefly black, the wing-coverts barred with grayish and ochraceous-white (in older specimens), or irregularly mottled with black and ochraceous (in younger individuals). Head streaked with black and ochraceous-white, lower parts mixed black and ochraceous, the relative amount of the two colors, and the depth of the ochraceous tint varying with the individual, but the ochraceous usually predominating posteriorly, the former being mostly in large suffused spots, chiefly on the breast and sides. Tibiæ usually immaculate, but sometimes narrowly barred with blackish.

Mr. Sharpe describes the tail of the "young male" as "ashy gray, mottled with black, more distinctly toward the apex, which is entirely black"; but we have seen no specimens in which the tail is not entirely black, even to the extreme base, except a narrow grayish terminal margin, present in most specimens. A young specimen from Brazil (No. 50,929, Sr. Don Fred. Albuquerque) is nearly uniform black beneath as far back as the tibiæ and crissum, which are deep yellowish ochraceous, with irregular black bars on the former, and zigzag spots of the same on the latter. In this specimen, the wing-coverts are pale gray, nearly white anteriorly, everywhere barred with dusky, with but little admixture of ochraceous; the pileum and nape are also nearly uniform black, nearly all the white or ochraceous being beneath the surface.

An adult from Bogota (No. 66,323) differs from Chilian examples of the same stage in having a glaucous or chalky cast to the black portions of the plumage, especially on the head, neck, back, and jugulum; the slaty bars of the abdomen, etc., are also narrower and fainter, those of the crissum being much broader and darker than elsewhere.

The tail and upper coverts are more often tipped with grayish than with white.

In an adult specimen, the bill was "black at the tip, yellowish-green at the base; eye light hazel; legs and toes chrome-yellow; claws black. Total length, 18½ inches."—(Scl. & Salv. P. Z. S. 1869, p. 155.)

List of specimens in United States National Museum.

Catalogue No.	Original No.	Condition of specimen.	Sex and age.	Locality.	Date.	From whom received.
13832	.....	M.	♀ ad.	Chili	.....	Lieutenant Gillies.
13909	.....	M.	♂ ad.	.....do	.....	Do.
48816	11	S.	♀ ad.	.....do	May —, 1863	National Museum, Chile.
48817	11	S.	— ad.	Chili (Santiago)	July —, 1864	Do.
50929	.....	S.	—juv.	Brazil	.....	Señor Don F. Albuquerque.
50932	.....	S.	—juv.	.....do	.....	Do.
66323	.....	S.	— ad.	Bogota, New Granada	.....	Mr. Hurlburt.

Other specimens examined.—Mus. Boston Soc. N. H., 6; Philad. Acad. N. S., 11; Am. Mus., N. Y., 4; G. N. Lawrence, 1; total, 29.

The sexes compare in measurements as follows:—

Sex.	Wing.	Tail.	Culmen.	Tarsus.	Middle toe.	No. specimens.
♂	18.25–18.50	8.70– 9.50	1.25–1.40	3.80–4.10	2.15	3
♀	19.75–23.00	9.50–13.50	1.20–1.25	4.00–4.30	2.40–2.60	5

GENUS ONYCHOTES, RIDGWAY.

Onychotes, RIDGWAY, Pr. Acad. Nat. Sci. Philad. Dec. 1870, 142; type, *O. gruberi*, nov. sp.—RIDGW. B. B. & R. Hist. N. Am. Birds, iii, 1874, 252 (outlines of generic characters).

CHARACTERS.—General form and size most similar to that of species of *Rupornis* and *Asturina*. Bill very short, the tip unusually obtuse; cere very large and broad on top, its length almost equal to the chord of the culmen, and its greatest breadth equal to its length. Superior tomium slightly lobed; gonys slightly convex. Nostril nearly circular, or properly semi-circular or broadly ovate, its upper outline being less curved than the lower, more horizontal, its direction nearly parallel with the commissure of the bill; a cartilaginous tubercle is seen within the nostril in its upper portion. Outstretched feet reaching to or beyond end of the tail; tarsus long and slender, nearly twice the length of the middle toe; outer toe decidedly longer than the inner, which reaches the second phalangeal articulation of the middle toe; hind toe shorter than the inner. Scutellation of the tarsi and toes as in the typical *Buteones*, there being a continuous single series of transverse plates on the posterior face of the former; those on the anterior face number 11–12. Claws proportionally large, those of the first and second toes considerably exceeding their digits in length; they are much graduated in size to the outer, which is only half the length of the posterior one; their shape is normally buteonine. A well-developed web between outer and middle toes. Wing short and much rounded, reaching to about the middle of the tail, which is slightly rounded, and more than half as long as the wing. Remiges, 24; rectrices, 12. Third, fourth, and fifth quills longest, and nearly equal; first shortest; second about equal to sixth; outer five with inner webs emarginated. Plumage generally dense and rather compact; tibial plumes short, reaching but little below the joint; upper third of the tarsus densely feathered in front and on sides. Lores quite densely covered with strong black bristles, these extending forward so as to cover the entire cere beneath the nostrils. Superciliary shield bare and prominent.

This buteonine form has no very near relative among the American *Falconidæ*, nor, indeed, among those of the Old World; and the several striking peculiarities of detail in its external structure, besides the existing uncertainty regarding its precise habitat, and the unknown history of the only two specimens known to exist in collections, render this bird one of extreme interest. The general aspect of this peculiar hawk is that of the smaller short-winged *Buteones* of tropical America; it agreeing very nearly in size with "*Buteola*" *minuta* and *B. brachyura*. The fuliginous plumage resembles also that of several species of the genus *Buteo*, so much so, in fact, that the original specimen was labeled "*Buteo fuliginosus* Sclater"; while in the normal, or lighter phase, there is a somewhat close resemblance to the plumage of the latter of the two species above mentioned. There are very many striking peculiarities of external structure, however, which mark it as one of the most strongly-characterized genera in the group to which it belongs, notably the densely-bristled lores and lower jaw, the broad, high cere, short, obtuse bill, and very long claws. In the latter feature, there is a close approach to the genus *Rostrhamus*, in which, however, the feet are much weaker, and the tarsus conspicuously shorter, while otherwise the bird is extremely different.

But one species is as yet known, and of this only two specimens, both of unknown history, exist in museums. The two specimens in question form part of the collection of the United States National Museum, and are supposed to have come from California.

ONYCHOTES GRUBERI.

Onychotes gruberi, RIDGWAY, Pr. Ac. Nat. Sci. Phila. Dec. 1870, 149 (description of fuliginous phase); B. B. & R. Hist. N. Am. Birds, iii, 1874, 254 (figure of fuliginous phase); Rod and Gun, vol. 6, No. 5, May 1, 1875, 65 (first description of white-breasted phase).

Onychotes grueberi, SHARPE, Cat. Acc. Brit. Mus. 1874, 158 (foot-note).

Hab.—California? (F. Gruber).

Wing, 10.10–11.50; tail, 6.50–7.30; culmen, about 0.80; tarsus, 2.70 2.80; middle toe, 1.45–1.60; posterior claw, 1.00; its digit, 0.80.

Adult.—Tail brownish-gray, the feathers with a hoary cast near the shaft, not paler at the tip, and crossed by a rather indefinite number (apparently from 9 to 11) of narrow and rather indistinct bars of dusky brown, these becoming gradually obsolete basally; the inner webs but little paler, becoming white only toward edges. *Light phase* (No. 62168, Nat. Mus.):—Above, chiefly dusky grayish-brown, beneath ochraceous white, deeper ochraceous on the middle of the breast and abdomen. Pileum and nape striped with blackish-brown and ochraceous-white, the former prevailing, the latter on the edges of the feathers; cheeks and sides of the neck with finer and fainter streaks; sides of the breast with narrow irregularly-lanceolate streaks of grayish-brown; sides with broader, ragged stripes, or longitudinal cloudings of the same, and tibial plumes with dusky shaft-streaks and faint grayish mottlings; longer lower tail-coverts with an irregular large spot of brownish-gray near the end. Lining of the wing deep creamy-buff, whiter along the outer edge, with a few scattered small spots of grayish-brown; under primary coverts pale grayish for the terminal portion, where marked with two or three narrow bars of darker. Inner webs of primaries entirely white to the emarginations, beyond which they are plain grayish, darker toward edges; no transverse bars are observable except on the inner quills. Axillars mostly white, irregularly spotted, and brokenly barred with brown, mixed with rusty, the brown predominating toward the end of the feathers. Upper parts slightly variegated, chiefly by whitish and dusky bars on the basal portion of the feathers; lesser wing-coverts faintly spotted with rusty; outer webs of secondaries and inner primaries with very indistinct darker bars. Wing, 11.50; tail, 7.30; tarsus, 2.80; middle toe, 1.60. *Fuliginous phase* (No. 41703, Nat. Mus.; *adult?*):—Everywhere dark grayish-brown, the feathers with darker shafts; feathers of the neck all round broadly edged with dull rusty; lining of the wing and tibial plumes dull cinnamon-rusty; flanks and crissum tinged with the same. Remiges as in the normal phase, but without trace of darker bars on outer webs, while those on the inner webs are more distinctly indicated. Tail as in the light phase. Wing, 10.10; tail, 6.50; culmen, about 0.80; tarsus, 2.70; middle toe, 1.45; posterior claw, 1.00; its digit, 0.80.

GENUS HERPETOTHERES, VIEILLOT.

"? *Physeta* VIEILLOT, 1816 (suppressed in 1818)." [*Fide* G. R. Gray.]
Herpetotheres VIEILL. Nouv. Dict. d'Hist. Nat. xviii, 1817, 317 (type *Falco cachinnans* Linn.).
Cachinna FLEM. Phil. Zoöl. ii, 1822, 236 (same type).
Macagua LESS. Traité d'Orn. 1831, 68 (same type).

Osteology.—Scapular process of the coracoid produced forward so as to meet the clavicle. Nasal bones almost completely ossified, leaving only a small circular nasal orifice with a firm bony rim and inclosed bony tubercle. Inferior surface of the supramaxillary with a median angular ridge. Superciliary process of the lachrymal greatly developed, consisting of a single broad piece extending nearly across the orbit. Posterior margin of the sternum truncated, entire, without foramina. General appearance and size of the skull exceedingly like that of *Falco communis*, but the supero-frontal width much greater, and the palatine surface correspondingly narrower; interorbital width of the frontal bone more than half the length of the skull from the base of the maxillary; width of the superciliary processes more than one-third their length;. width of the conjoined palatines less than twice the width of the superciliary process, and less than half their own length; tomium of the supramaxillary without tooth or notch; nostril opening against the anterior edge of the cere, its bony rim much elevated on the posterior side. Mandible very broad and strong, with a large, longitudinal, oblong-ovate vacuity. Keel of the sternum about equal in length to the scapula, much longer than the coracoids and furcula; greatest width of the sternum about two-thirds its length.*

General external features.—Bill much compressed, very short and deep, its height through the base being about equal to the chord of the culmen, whose curve forms about one-third the circumference of a circle; gonys very convex, ascending abruptly terminally; superior tomium very slightly sinuated; end of the lower mandible divided frontally by an angular notch. Cere short, almost concealed by the rigid bristles of the lores and forehead. Nostril large, circular, against the anterior edge of the cere, its bony rim much elevated superiorly and posteriorly, and its bony tubercle not prominently exposed. Feet very robust; tarsus longer than the middle toe; lateral toes nearly equal, but the outer appreciably the longer; membrane between middle and outer toes well developed. Covering of tarsus and toes consisting of irregularly hexagonal, roughly imbricated, small scales, with no tendency to larger size on any part; terminal joint of the toes with three broad scutellæ. Claws normal, of moderate length and curve, the edges unusually sharp.

Pterylosis.—Distribution of the tracts much as in *Falco*, but with the dorsal stem of the spinal tract enlarged on all sides, undivided, and sparsely feathered. Lumbar tracts distinct, but short and separated from the crural tracts. Inferior tract narrow in all its parts, inner branch indistinct at the end of the gular portion; outer branch completely separated from the pectoral stem, somewhat broader than the narrow main stem itself, and distinct from it; ventral portion of the main stem removed far outward, running along the margin, and terminating laterally in front of the anus.—(NITZSCH.)

Plumage full and soft, except about the head; feathers of the crown developed into a full depressed crest of lanceolate feathers with very rigid shafts; orbital region with scattered hairs; eyelids strongly

* There are no other bones of this remarkable form accessible for examination.

bristled; lores densely bristled; loral and frontal bristles invading the cere so as to almost cover it, especially on the upper surface, where they grow to the anterior edge; superciliary shield bare. Wing moderate, rounded, but the primaries straight; the primaries soft and obtuse; fourth quill longest; first about equal to the ninth; inner webs of the outer four distinctly sinuated, the sinuation disappearing on the sixth. Tail a little shorter than the wing, much rounded, the feathers soft and appreciably tapering toward the rounded ends.

Relationships.—From its external appearance, this curious hawk conveys no suspicion of near affinity with the *Falcones*, except in the peculiar shape of its nostrils. The plumage has the softness of that of the weaker forms of the *Buteoninæ* (notably the genus *Harpagus* and the group *Pernes*), while the scutellation of the feet calls at once to mind the genus *Circaëtus*, to which *Herpetotheres* bears the closest resemblance in its general aspect. Yet with this ignoble appearance when in death or when at rest, this species exhibits, when aroused, an irritability and spirit said to exceed even that of the true falcons. The bony structure of this form shows at once its very close affinity with the *Falcones*, the osteology presenting only very slight differences, the most important of which is the greater elongation of the hallux compared with the length of the lateral toes.

This form is of arboreal habits, and subsists chiefly on reptiles. Only one species is known, the Laughing Falcon of the older authors (*Falco cachinnans* Linné).

HERPETOTHERES CACHINNANS.

LAUGHING FALCON.

Falco cachinnans LINN. Syst. Nat. i, 1766, 128.
Astur cachinnans CUV. Règ. An. i, 1817, 320.—SPIX, Av. Bras. i, 1824, 8, tab. iii *a*.—SCHLEG. Mus. Pays-Bas, Astures, 1862, 26; Rev. Acc. 1873, 68.
Herpetotheres cachinnans VIEILL. Nouv. Dict. xviii, 1817, 317.—VIEILL. & OUD, Gal. Ois. i, 1825, 47, pl. 19.—CASSIN, Pr. Ac. Nat. Sci. Phila. iv, 1848, 87 (Vera Cruz).—BONAP. Consp. Av. i, 1850, 30.—STRICKL. Orn. Syn. i, 1855, 75.—BURM. Th. Bras. ii, 1855, 90.—SCLATER, Proc. Zoöl. Soc. Lond. 1857, 201 (Jalapa); *ib.* 1868, 629 (Venezuela).—LAWR. Ann. Lyc. N. Y. ix, 1868, 132 (Costa Rica); Mem. Bost. Soc. N. H. ii, 1874, 300 (Mazatlan; biographical notes).—SUMICHR. *ib.* i, iv, 1869, 560 (Vera Cruz; hot region).—GRAY, Hand List, i, 1869, 31.—SALVIN, P. Z. S. 1870, 214 (Veragua).—SCL. & SALV. *ib.* 838, (coast Honduras); Nom. Neotr. 1873, 122.—PELZ. Orn. Bras. 1871, 7, 398.—RIDGW. Pr. Bost. Soc. N. H. 1873, 52.—SHARPE, Cat. Acc. Brit. Mus. 1874, 278.
Cachinna cachinnans FLEMING, Phil. Zoöl. ii, 1822, 236.
Dædalion cachinnans VIGORS, Zoöl. Journ. i, 1824, 338.
Macagua cachinnans LESSON, Traité Orn. 1831, 63.
Circaëtus cachinnans KAUP, Mus. Senck. iii, 1845, 260.
Cachinna herpetotheres GRAY, Gen. B. i, 1845, 15, pl. 7, fig. 4.
Macagua AZARA, Pax. Par. i, 1802, 81.—HARTL. Ind. Azara, 1847, 2.

Hab.—Entire intertropical region, from Mazatlan, Tehuantepec, and Vera Cruz to Bolivia and Paraguay. Not recorded from the Andean district.

Wing, 10.60–11.80; tail, 8.50–10.00; culmen, 0.85–1.00; tarsus, 2.15–2.60; middle toe, 1.60–1.90. Third to fifth quill longest; first equal to or longer than the ninth. *Adult:*—Head, neck, entire lower parts, and longer upper tail-coverts pale ochraceous or ochraceous-white; feathers of the pileum with black shaft-streaks. A broad patch or "spectacle" of black on the side of the head, involving the posterior half of the lores, the orbital region, cheeks, and auriculars, and extending thence around the upper part of the nape in a broad, abruptly-defined collar, leaving an equally well-defined nuchal collar of ochraceous or whitish below it. Upper surface, in general, blackish-brown, the primaries much varie-

gated on their basal half (or more) with ochraceous. Tail deep black, crossed by six to eight sharply-defined bands of clear, pale ochraceous, these bands being narrower on the middle feathers, but wider on the outer, than the black ones; the terminal ochraceous band much narrower than the others. "Iris brown; cere yellow; feet dull white" (Sumichrast, mss.). *Young?* (No. 67884, ♂, Nat. Mus. Costa Rica Prof. Wm. M. Gabb):—As described above, but the ochraceous deeper, and having everywhere, except along the median line below, delicate shaft-streaks of rusty-brown; the longer scapulars and tertials irregularly bordered and indented with rusty-rufous; the bands on the tail are only six in number, including the terminal one, and consist of transverse spots, which on the middle feathers do not touch the edges. Bill black; cere and base of lower mandible lemon-yellow; orbital space dusky; tarsi and toes dull brownish-gray; claws dusky black.

Biographical notes.

"This remarkable species is only to be met with in the thick forests of the warmer regions..... I found it equally as common in the locality of Tehuantepec as that of Mazatlan; northward its range stops in the densely wooded districts of the western and southern ports of Sonora. It is one of the most peculiar and easily identified hawks of this region, not only from its well-defined markings, its large and broadly crested head, but its well-known scream of guaco (pronounced *waco*), which is often repeated for an hour or so at a time, either late in the evening or early in the morning. When heard at twilight amid the solemn and eternal woods of these latitudes a feeling of melancholy is produced upon the weary traveler, far from his native land, as he threads some dark and intricate path, crowded on all sides with impenetrable undergrowth, and overhung with the arched branches of trees of immense size and strange forms. This hawk is often found in pairs, and the answer to each other's call makes, at times, a singular medley of talking and laughing together. It is seldom seen in an open country, or soaring at any great height. Its flight is a quick successive movement of the wings, passing through the woods or across an opening with rapid ease. It subsists almost entirely upon reptiles and rodents, which its stout claws are well adapted for holding, and its rough, scaly legs are armored against their bites. It sometimes, however, preys upon birds."—(GRAYSON, "Birds of Western and Northwestern Mexico."—Mem. Boston Soc. Nat. Hist. vol. ii, part iii, number ii, p. 300.)

List of specimens in United States National Museum.

Catalogue No.	Corresponding No. of—	Original No.	Nature of specimen.	Sex and age.	Locality.	When collected.	From whom received.	Collected by—
16526	....	....	....	.....	Brazil	.....	Capt. T. T. Page, U. S. N.	
30410	....	....	....	.....	Costa Rica	Aug. —, —	Dr. A. von Frantzius	
39081	....	3	....	♀	....do	Aug. 18, 1864	....do	
50770	....	612	....	♀	Mazatlan	.....	Col. A. J. Grayson	
51026	....	....	....	♂	Panama	.....	J. McLeannan	
57843	....	209	....	♂ ad.	Tehuantepec	Dec. 15, 1868	Prof. F. Sumichrast	
59513	....	914	....	.....	....do	Oct. —, 1869	....do	
62131	....	2572	....	.....	Calobre, Veragua	Oct. —, 1869	O. Salvin	
62689	....	66	....	Ad.	Tehuantepec	.....	Dr. Speer	
67884	....	231	....	♂ ad.	Talamanca, Costa Rica	.....	Prof. W. M. Gabb	

Other specimens examined.—Mus. Philad. Acad. N. S., 6; mus. Boston Soc., N. H., 3 Mus. Comp. Zoöl., 1; G. N. Lawrence, 2; other sources, 1; total, 23.

GENUS HETEROSPIZIAS, SHARPE.

Urubitinga AUCT. (*nec* LAFRESNAYE).
Spizigeranus GRAY, Hand List, i, 1869, 9 (*nec* KAUP, 1844).
Heterospizias SHARPE, Cat. Acc. B. M. 1874, 160. Type *Falco meridionalis* GM.

CH.—Similar to *Urubitinga*, but wings larger proportionally, reaching to or beyond the end of the comparatively short tail. Tibial plumes better developed, and feathers of the pileum longer and more lanceolate. Plumage more variegated, rufous prevailing. Five outer primaries with inner webs sinuated; third, fourth, and fifth quills nearly equal and longest, the fourth usually exceeding the rest; first shorter than the seventh. Tail more than half as long as the wing, slightly, but decidedly, emarginated, the lateral pair being longest.* Tarsus much more than twice as long as middle toe; outer toe nearly as long as the middle; inner much shorter; hind toe a little shorter than the inner. Claws moderate in size, of normal form, decidedly graduated, the outer being only about half the length of the posterior, which is equal to its digit. Toes with large transverse plates in an uninterrupted series, and tarsus with continuous frontal and posterior series of similar scutellæ. A well-developed web between outer and middle toes. Less than one-third the upper portion of the tarsus feathered in front. Bill rather small, exactly as in *Urubitinga anthracina*.

With a general correspondence to *Urubitinga* in most of the external features of form, this genus, or more properly subgenus, differs sufficiently in the greater development of the remiges and tibial plumes, the more lanceolate form of the feathers of the pileum, and the strikingly different coloration.

HETEROSPIZIAS MERIDIONALIS.

Falco meridionalis LATH. Ind. Orn. i, 1790, 36.
Rupornis meridionalis KAUP, Contr. Orn. 1850, 63.
Buteogallus meridionalis SCL. P. Z. S. 1860, 228.
Buteo meridionalis SCHL., Mus. P.-B. Buteones, 1862, 17; Rev. Acc. 1873, 110.—GRAY, Hand List, i, 1869, 9.
Urubitinga meridionalis SCL. & SALV. P. Z. S. 1867, 589; 1869, 252 (Plains of Valencia, Venezuela); *ib.* 634 (Arg. Rep.); Nom. Neotr. 1873, 119.—WYATT, Ibis, 1871, 382.—PELZ. Orn. Bras. 1871, 7, 394.—LEE, Ibis, 1873, 136 (Arg. Rep.).
Urubitinga (*Spizigeranus*) *meridionalis* RIDGW. Pr. Boston Soc. N. H., May, 1873, 63.
Heterospizias meridionalis SHARPE, Cat. Acc. B. M. 1874, 160.
Circus rufulus VIEILL. N. D. iv, 1816, 466.
Astur rufulus STRICKL. Orn. Syn. i. 1855, 422.
Falco rutilans LICHT. Verz. Doubl. 1823, 60.—TEMM. Pl. Col. i, 1824, pl. 25.
Circus rutilans STEPH. Gen. Zoöl. xiii, 1826, 43.
Buteo rutilans LESS. Man. i, 1828, 104.
Hypomorphnus rutilans CABAN. Arch. f. Naturg. 1844, 264; Tschudi Fauna Per. 1844, 17, 84.
Asturina rutilans BURM. Th. Bras. ii, 1856, 80.
Aquila buzon SPIX, Av. Bras. i, 1824, 6.
Rufous-headed Falcon LATH. Gen. Synop. Suppl. 1787, 33.
Carilan de estero Acanelada AZARA, Pax. Par. i, 1802, 72.—HARTL. Ind. Azara, 1847, 1.

Hab.—South America, from New Granada to Paraguay and Buenos Ayres.

Wing, 15.10–18.50; tail, 8.00–11.00; culmen, 1.00–1.10; tarsus, 3.80–4.50; middle toe, 1.65–1.85. *Adult*:—General color pale cinna-

*Remiges 25. Pterylosis as in *Buteo*, but external branch of the pectoral stem of the inferior tract only half free, as in *Haliaëtus*.—(NITZSCH.)

mon, deepening into bright rufous on the alulæ, primary coverts, primaries, and tibiæ, and narrowly barred (except on the wings*) with dusky. Greater and middle wing-coverts and dorsal region generally grayish-dusky, inclining to black on the wing-coverts; terminal portion (about the exposed one-fourth) of the secondaries and primaries deep black. Tail deep black, broadly tipped with grayish-white, and crossed about the middle by a broad zone of the same; upper tail-coverts black, tipped with white. Head and neck pale cinnamon, like the lower parts, the head without transverse bars, but the feathers with dusky shaft-streaks; auriculars and cheeks tinged with cinereous. *Young:*—Head, neck, and breast pale ochraceous (varying to white) with shaft-streaks of dark brown, the breast with large longitudinal spots or patches of the same. Tail dusky, transversely mottled, or narrowly and irregularly barred, with dull grayish, tinged with reddish.

List of specimens in United States National Museum.

Catalogue No.	Condition of specimen.	Sex and age.	Locality.	From whom received.
32968	S.	♀ ad.	New Granada	Verreaux.
36666	S.	— ad.	Brazil (Para)	Nat. Hist. Museum of Rio.
50930	S.	— ad.	do	Sr. Don F. Albuquerque.
50931	S.	— ad.	do	Do.
59006	S.	— ad.	Argentine Republic (Corrientes)	Capt. T. J. Page, U. S. N.

Other specimens examined.—In mus. Philad. Acad., 7; Am. Mus., N. Y., 2; Boston Soc 3; total, 17.

In measurements, the sexes differ as follows, according to identifications of sex on labels:—

Sex.	Wing.	Tail.	Culmen.	Tarsus.	Middle toe.	No. specimens measured.
♂	15.10–15.16	8.00–8.30	1.00	3.80–4.25	1.65	6
♀	17.25–18.00	9.50–11.00	1.00–1.10	4.35–4.50	1.80–1.85	3

* Where there are, however, sparse and more indistinct bars on the lesser-covert region.

GENUS BUTEOGALLUS, LESSON.

Buteogallus LESSON, Traité Orn. 1831, 83. Type, *Falco æquinoctialis* GMELIN.

CH.—Extremely similar to *Urubitinga*, the main difference being in the coloration; but differing somewhat also in the relative proportion of the lateral toes and the degree of development of the loral bristles. The latter are almost entirely wanting, and the outer toe is not appreciably longer than the inner.

It is extremely doubtful whether this form should be allowed more than subgeneric rank, the resemblance in most respects to *Urubitinga* being so exceedingly close. The points of difference * pointed out above are indeed trifling, though characteristic; and although the adult plumage is strikingly different from that of any of the species of *Urubitinga*, the young stage is quite similar to that of *U. anthracina*.

BUTEOGALLUS ÆQUINOCTIALIS.

Falco æquinoctialis GM. S. N. i, 1788, 265.
Buteo æquinoctialis GRAY, List Acc. B. M. 1848, 37; Hand List, i, 1869, 9.—STRICKL. Orn. Syn. i, 1855, 42.—SCHL. Mus. P.-B. Buteones, 1862, 18.
Morphnus æquinoctialis GRAY, Gen. iii, App. 1849, 1.
Hypomorphnus æquinoctialis SUND. Crit. om Levaill. 1858, 25.
Urubitinga (*Buteogallus*) *æquinoctialis* RIDGW. Pr. Boston Soc. N. H., May, 1873, 63.
Buteogallus æquinoctialis SCL. & SALV. Nom. Neotr. 1873, 119.—SHARPE, Cat. Acc. B. M. 1874, 212.
Falco buson DAUD. Tr. ii, 1800, 168.
Buteo buson VIG. Zoöl. Journ. i, 1824, 340.
Buteogallus buson GRAY, List Gen. 1840, 2.—BONAP. Consp. i, 1850, 17.
Daptrius buson GRAY, List Acc. B. M. 1844, 14.
Morphnus buson GRAY, Gen. i, 1845, 15.
Le Buson LEVAILL. Ois. d'Afr. i, 1799, 86, pl. 21.—SUND. Crit. om Levaill. 1858, 25.

Hab.—Northern South America. Columbia (SHARPE); Demerara (BR. MUS., *fide* SHARPE); Cayenne (MUS. BOSTON SOC.).

Wing, 12.25–13.40; tail, 7.00–7.50; culmen, 1.00–1.05; tarsus, 2.80–3.00; middle toe, 1.50–1.70. Third quill longest;* first longer than ninth. Tail even, or slightly emarginate. *Adult:*—Head, neck, and upper parts generally blackish-brown; lower parts, secondaries (except a broad terminal band), and broad borders to the larger scapulars lateritious-rufous, or brick-red, the lower parts barred transversely with dusky. Tail deep black, narrowly tipped with white, and crossed about the middle portion by a narrow band (generally interrupted) of pale grayish. *Young:*—Above plain dull grayish-brown, the primaries black. Feathers of the head, neck, and back narrowly edged with dull ochraceous; secondaries obscurely barred with dusky and wing-coverts sometimes bordered with ochraceous. Beneath, pale ochraceous (or ochraceous-white), with a collar of dusky spots across the lower part of the throat; breast and abdomen nearly immaculate; tibiæ plain, or faintly spotted transversely with dusky. Tail grayish-brown, mixed on the basal half of the outer, and on nearly the whole extent of the inner, webs with ochraceous, and narrowly and obscurely barred toward the base with dusky.

Seven specimens examined, in mus. Philadelphia Academy.

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* *B. æquinoctialis* agrees with *U. anthracina* in the following important external details: Remiges 24; outer four primaries with inner webs shallowly sinuated, the sinuation just appreciable on the fourth. Tail even or slightly emarginated.

GENUS BUSARELLUS, LAFRESNAYE.

Busarellus LAFR. D'Orb. Dict. d'Hist. Nat. ii, 1842, 785-6. Type, *Falco nigricollis* LATHAM.
Icthyoborus KAUP, Contr. Orn. 1850, 76. Same type.

CH.—General form and appearance of *Buteogallus æquinoctialis*. Bill, feet, and claws very strong; wings large (but primaries short), and outstretched feet reaching beyond the end of the rather short, nearly even tail. Bill, cere, and nostril very similar to that of *Pandion*, but the culmen less arched, and the top of the cere elevated instead of depressed. Tarsus nearly twice the middle toe, with a frontal and posterior series of transverse scutellæ, these sometimes fused into continuous plates. Lateral toes nearly equal (but the outer perceptibly the longer), the posterior a very little shorter than the inner, and the middle one only the distance of its terminal joint longer. Inferior surface of the toes with acute papillæ, as in *Pandion*. Claws very strong, of normal shape, considerably graduated, and deeply grooved beneath. No trace of a web between the toes. Head normally feathered; the feathers, as well as those of the neck, lanceolate, the occipital ones somewhat elongated. Secondaries much developed, and very broad, fifteen in number. Primaries but little longer than the secondaries; third, fourth, or fifth longest, first shorter than the eighth; outer six with their inner webs very shallowly sinuated. Tail less than half the wing, even, or very slightly rounded. Plumes of the outer face of the tibiæ short and close, as in *Onychotes*.

This strongly-characterized and very remarkable genus exhibits a striking analogy to *Pandion* in the very strong and slightly-graduated claws, the close feathering of the tibiæ, the general form of the bill, and the sharp spicules of the toe-pads. It is said to be piscatorial in its habits, hence these modifications. It differs very essentially from *Pandion*, however, in the deep grooving of the claws, the soft texture of the plumage, the buteonine scutellation of the tarsi and toes, and indeed in all essential features. It is much more nearly related to the haliaëtine group, especially to the remarkable Australian genus *Gypoictinia*, from which, however, it is widely distinct, as it is from all American genera. But one species is thus fark nown.

BUSARELLUS NIGRICOLLIS.

Falco nigricollis LATH. Ind. Orn. i, 1790, 35.
Buteo nigricollis VIEILL. N. D. iv, 1816, 437.—GRAY, Gen. i, 1845, 15; Hand List, i, 1869, 9.—PUCHER. Rev. et Mag. Zool. 1850, 85.—BURM. Th. Bras. ii, 1856, 47.—SCHL. Mus. P.-B. Buteones, 1862, 17.—LAWR. Mem. Boston Soc. N. H. 1874, 302 (N. W. Mexico; biography).
Morphnus nigricollis GRAY, Gen. iii, App. 1849, 1.
Icthyoborus nigricollis KAUP, Contr. Orn. 1850, 76.—PELZ. Orn. Bras. 1871, 3, 394.—RIDGW. Pr. Boston Soc. N. H., May, 1873, 69.
Buteogallus nigricollis STRICKL. Orn. Syn. i, 1855, 43.—CASSIN, Pr. Ac. Nat. Sci 1860, — (Truando, N. G.) — SCL. & SALV. Nom. Neotr. 1873, 119.
Busarellus nigricollis SHARPE, Cat. Acc. B. M. 1874, 211.
Falco busarellus DAUD. Tr. ii, 1800, 168 (ex Levaill.)
Circus busarellus VIEILL. Enc. Méth. iii, 1823, 1212.
Buteo busarellus VIG. Zoöl. Journ. i, 1824, 340.—GRAY, Gen. i, 1845, 15.
Buteogallus busarellus BONAP. Consp. i, 1850, 17.
Falco melanobronchos SHAW, Gen. Zoöl. vii, 1809, 167.
Circus leucocephalus VIEILL. N. D. iv, 1816, 465.

* Second and fourth just appreciably shorter.

Aquila milvoides SPIX, Av. Bras. i, 1824, pl. 1*d*.
Morphnus milvoides CUV. Règ. An. i, 1829, 330.
Haliaëtus milvoides GRAY, List. Acc. B. M. 1844, 12; Gen. i, 1845, 17.
Busard roux de Cayenne MAUD. Enc. Méth. 1784, 543.
Black-necked Falcon LATH. Gen. Synop. Suppl. i, 1787, 30.
Le Buserai LEVALL. Ois. d'Afr. i, 1799, 84, pl. 20.—SUND. Crit. om Levaill. 20 1853, 25.
Buzzaret LATH. Gen. Syn. Suppl. ii, 1801, 32.
Cabeza blanca AZARA, Pax. Par., i, 1802, 78.

Hab.—Tropical America, south to Paraguay, north to Mazatlan, Western Mexico.

Wing, 15.00–17.50; tail, 7.30–8.50; culmen, 1.10–1.30; tarsus, 3.00–3.50; middle toe, 1.75–2.20. *Adult:*—General color deep rufous, becoming white on the head; a transverse jugular patch, secondaries, primaries, and terminal half of the tail black. Feathers of the upper surface, including the pileum and nape, with shaft-streaks of black, these widening into stripes on the scapulars. Basal half of the tail usually more or less barred with black (especially on the inner webs), and the tip sometimes narrowly rufous. *Young:*—Head, neck, tail, and primaries as in the adult. Whole breast blackish; tibiæ and crissum barred with black. Upper parts thickly barred with black, which prevails on the dorsal region. A dusky stripe from the eye across the auriculars.

Mexican specimens are larger and lighter-colored than those from South America.

List of specimens in United States National Museum.

Catalogue No.	Original No.	Condition of specimen.	Sex and age.	Locality.	Date.	From whom received.
16528	.....	.....	— ad.	Brazil	.....	Capt. T. J. Page.
17763	78	.....	♂ ad.	Truando, New Granada	.....	Arthur Schott.
17784	78	.....	♀ ad.	.....do	.....	Do.
22064	.....	.....	♂ ad.	Amazonia	.....	Verreaux.
27762	897	.....	♂ ad.	Mazatlan, Mexico	—— —, 1868	Col. A. J. Grayson.
35007	108	.....	— ad.	Paraguay	Aug. 28, ——	Captain Page.

Other specimens examined.—In mus. Philad. Acad., 6; Am. Mus., N. Y., 2; Boston Soc., 4; total, 18.

The sexes compare in measurements as follows:—

Sex.	Wing.	Tail.	Culmen.	Tarsus.	Middle toe.	No. specimens.
♂	15.00–15.50	7.50–7.80	1.10	3.15–3.20	1.80–1.85	2
♀	17.00	8.50	1.30	3.30	2.20	1

Biographical notes.

"No locality that I have ever visited in my researches for the objects pertaining to ornithology equals that where the Mazatlan River forms an expansive valley near the sea-coast, for the great numbers and varieties of hawks there met with. They seem to assemble in this favorite spot from far and near, and almost all the known species are

represented here during the dry season. This may be accounted for from the fact that this extensive region is diversified with rudely-cultivated farms, old fields overgrown with brambles and weeds, impenetrable thorny woods and forests of large trees, interspersed here and there with stagnant lagoons and lakes, through the center of which wind the clear waters of the Rio Mazatlan; there abounds animal life in great abundance; the old neglected fields, overgrown with matted vegetation, harbor innumerable field-mice and other rodents; here various species of lizards and snakes dart through the thickets when scared from their sunny beds. The lagoons furnish other reptiles; swarms of ducks and various kinds of water-fowl resort to their slimy waters; the woods are enlivened with great numbers of birds, all of which furnish to the different species of hawks their favorite prey.

"The remarkable species which heads this article I discovered in this locality; it is entirely new to me, and I have not yet seen it mentioned in any volume at my command; the specimen has been sent to the National Institution at Washington for identification. The flight of this hawk seems rather heavy, resembling somewhat the common fish-hawk, the wings appearing very broad and the tail remarkably short. Upon examining the contents of the stomach, after skinning it, I found only the remains of fish, one of which had been but freshly devoured; it was a species of perch found in the lagoons and rivers of this region."—[Col. A. J. Grayson, in Mem. Boston Soc. Nat. Hist. 1874, p. 302.]

GENUS THRASAËTUS, GRAY.

Harpia VIEILLOT, Analyse, 1816, 24. Type, *Falco harpyia* LINN. (not of OSCHENH. 1810).
Harpyia CUVIER, 1817. Same type.
Thrasaëtus GRAY, P. Z. S. 1837, 108. Same type.
Nethrophrontes GLOGER, Handb. Naturg. 1842, 219. Same type.
Anopaia HALDEMAN, Pr. Ac. Nat. Sci. Philad. 1842, 188. Same type.

CH.—Form that of *Spizaëtus*, but organization more robust throughout, and tarsi almost entirely bare. Bill robust (similar to that of *Spizaëtus coronatus*); arch of the culmen forming about one-third the circumference of a circle, but the terminal curve rather abrupt, the tip inclining backward; upper tomium moderately lobed. Nostril oval, obliquely vertical, beveled off anteriorly to the edge of the cere. Feet exceedingly robust and powerful; tarsus less than twice the length of the middle toe; lateral toes nearly equal, the outer not appreciably longer than the inner, and very conspicuously weaker; middle toe exceeding the lateral toes by the length of its terminal phalanx; hind toe robust and powerful, nearly equal to the inner. Claws large, powerful, but rather obtuse, greatly graduated in size, the outer being scarcely more than one-third the inner in length; inner and posterior claws equal to their digits. Web between outer and middle toes well developed. Scutellæ of tarsi and toes rough, and very irregular; they are generally of irregular hexagonal shape, and small, but they enlarge into transverse plates on the toes (except the basal phalanx), and on the front of the tarsus, where they form a short series of about ten broad scutellæ; those of the posterior face are much larger, but very irregular both in size and arrangement, but they form a somewhat interrupted, and sometimes double series, which twists to the outer side toward the lower portion. Plumage generally full, the feathers broad and soft, with gently convex tips. Lores scantily bristled; tibiæ clothed with close, compact, very short feathers, extending in front over the upper half of the tarsus. Feathers of the posterior portions of the head and neck greatly developed, the occipital plumes much elongated, forming a broad, depressed crest, erectile at pleasure, those of the sides and hinder part of the neck forming when erected a broad ruff. Wing very short; primaries not reaching beyond the secondaries. Fifth, sixth, or seventh primaries longest; first shortest; outer seven with their inner webs very shallowly sinuated, the sinuation being perceptible on the last. Tail very long, nearly equal to the wing, even, the feathers strong and broad.

THRASAËTUS HARPYIA.

HARPY EAGLE.

Aquila cristata BRISSON, Orn. 1760, 446.
Vultur harpyia LINN. S. N. i, 1766, 446 (Adult.)
Falco harpyia GM. S. N. i, 1788, 251.
Gypaëtus harpyia DAUD. Tr. ii, 1800, 27.
Thrasaëtus harpyia GRAY, P. Z. S. 1837, 108; Gen. i, 1845, 15, Hand List, i, 1869, 16. —BONAP. Consp. i, 1850, 29.—STRICKL. Orn. Syn. i, 1855, 26.—LAWR. Ann. Lyc. N. Y. 1862, 7 (New Granada).—SCL. & SALV. P. Z. S. 1864, 368 (Isth. Panama); Nom. Neotr. 1873, 120.—SHARPE, Cat. Acc. B. M. 1874, 224.
Morphnus harpyia CAB. & TSCHUDI, Arch. f. Naturg. 1844, 96, 265.—PELZ. Orn. Bras. 1871, 4, 397.
Astur harpyia SCHL. Mus. P.-B., Astures, 1862, 25.
Morphnus (*Thrasaëtus*) *harpyia* RIDGW. Proc. Boston Soc. Nat. Hist. 1873, 72.
Vultur coronatus JACQ. Beitr. 1784, 15.
Gypaëtus coronatus DAUD. Tr. ii, 1800, 28.

Falco jacquini GM. S. N. i, 1788, 251.
Falco cristatus GM. *l. c.* 260.
Falco destructor DAUD. Tr. ii, 1800, 60.—TEMM. Pl. Col. i, 1824, pl. 14.
Harpyia destructor CUV. Règ. An. i. 1817, 317.—HALLOWELL, Pr. Ac. Nat. Sci. Philad. 1846, 84–88 (anatomy and osteology).—D'ORB. Voy. Am. Mérid. Ois. 1847, 21.—BURM. Th. Bras. ii, 1856, 59.
Nothrophrontes destructor GLOG. Handb. Naturg. 1842, 219.
Morphnus destructor LICHT. Nomencl. 1854, 2.
Falco imperialis SHAW, Gen. Zoöl. vii, 1809, 52, pl. 15.
Harpyia imperialis STEPH. Zoöl. xiii, 1826, 17.
Falco regalis SHAW, *l. c.* 56.
Falco caracca SHAW, *l. c.* 64.
Falco calquin MOLINA, St. Chile, 1810, 220.
Harpyia maxima VIEILL. Enc. Méth. iii, 1823, 1249.
Harpyia ferox LESS. Tr. 1831, 50.
L'Aigle hupé du Brésil BRISS. Orn. i, 1760, 446.
Caracoa Falcon LATH. Gen. Synop. i, 1781, 81.
Crested Eayle LATHAM, Synop. i, pt. i, 1781, 6, 7 (in part).
Crested Falcon DILLON, Trav. Spain, 1782, 80, pl. 3.
Grand Aigle de la Guiane MAUD. Enc. Méth. iii, 1784, 1250.
Crowned Vulture LATHAM, Syn. Supp. 1787, 5.
L'Ouira ouassou SONN. ed. Buffon N. H. xxxviii, 1806, 47, pl. 7, fig. 1.

Hab.—The whole of tropical America, south to Bolivia and Paraguay and north to Middle Mexico; Mirador and Tehuantepec, Mexico (NAT. MUS.); Costa Rica (NAT. MUS.); British Guiana (BR. MUS. *fide* SHARPE).

Wing, 21.00–24.50; tail, 16.00–18.50; culmen, 1.80–2.20; tarsus, 4.50–5.00; middle toe, 2.85–3.80; hind claw, 2.25–3.00; outer claw, 1.10–1.30. *Adult*:—Entire upper parts and jugulum plain brownish-black, the jugular patch abruptly terminated posteriorly, with a convex outline, and sharply defined against the white of the remaining lower parts. Tibiæ barred with black—elsewhere beneath usually immaculate. Head and neck uniform ashy, paler on the throat, darker on the crest. Tail crossed by about four bands of mottled ashy, nearly as wide as the black ones. *Young*:—Above light ash, marbled with blackish. Tail deep ash, marbled with black—this disposed into about five broken bands on the middle feathers, but confused on the others; secondaries and primaries mottled with dusky. Head, neck, and lower parts white, the long crest-feathers and the breast tinged with pale ashy.

A young male from the Isthmus of Tehuantepec (No. 54,224, Nat. Mus., October 8, 1868; F. Sumichrast) differs from the description of the young as above in the following particulars. Only the middle pair of tail-feathers are colored as described, they having five bands each of dark ashy and black, the bands of the two colors about equal in width, the former terminal. The other tail-feathers are wholly gray, less glaucous than the intermediæ, very indistinctly mottled with darker, and without trace of transverse bands, except an approximation to a subterminal one in the presence of a blackish spot next to the shaft near the end of each feather. The bird is evidently in transition-plumage, so that the intermediæ probably represent the adult dress, and the other rectrices the first plumage; traces of the coming adult livery are seen in the admixture of numerous black feathers among the lesser wing-coverts and scapulars, the longer crest-feathers, and across the jugulum, portions which are entirely black in the adult. Some of the feathers of the lower parts are tinged with ochraceous, but whether this is natural or caused by the stain of ochreous earth, is doubtful. According to Professor Sumichrast's notes on the original label, the iris is dark brown, cere and bill black, and the feet yellowish-white.

List of specimens examined.—National Museum, 4; Philad. Acad., 2; mus. G. N. Lawrence, 1; Boston Soc., 2; total number of specimens examined, 9.

GENUS MORPHNUS, CUVIER.

Morphnus CUVIER, Règ. An. 1817, 318. Type, *Falco guianensis* DAUDIN.
"*Morphinus* FLEMING, 1822", *fide* GRAY.

CH.—Form similar to that of *Thrasaëtus*, but weaker and more slender. Tarsus more than twice the length of the middle toe; toes very short, the lateral ones about equal in length (the outer not appreciably longer), the hind toe decidedly shorter than the inner. Claws large, but greatly graduated in size, that of the hind toe exceeding its digit, the outer much less than half its length. Scutellation of the feet much more distinct and regular than in *Thrasaëtus*, the tarsus having distinct and continuous frontal and posterior rows of broad, regular, transverse scutellæ, and those of the toes uninterrupted nearly to the base; those on the outer side of the tarsus, between the frontal and posterior series, are larger than those on the inner side. Wings and tail as in *Thrasaëtus*, but the latter longer and more rounded. Plumage generally the same, but occupital crest composed of narrower feathers.

The genera *Thrasaëtus* and *Morphnus* have so many characters in common, while in the same they differ so much from all the *Falconidæ* more nearly related to them in other respects, that they may be considered as forming a group by themselves, which may be designated by the term *Morphni*. They are very closely related to the *Spizaëti*, to which *Thrasaëtus* exhibits a very close approach through the equally large and powerful African species *S. bellicosus* and *S. coronatus*, which, with the present bird, constitute the largest and most powerful eagles in the world. It is a question whether the African species just named are not in reality more nearly related to *Thrasaëtus* than to the smaller *Spizaëti*; but this we cannot decide at present, having no specimens of either at hand. The two genera under consideration differ, however, from all the *Spizaëti*, including the species above named, in the nudity of the tarsus, which, instead of being densely feathered all round, as in *Aquila*, is feathered only on the upper portion in front, the rest being roughly scaled, with larger scutellæ before and behind. The "group *Morphni*," composed of these two genera alone, may be characterized as follows:—

CH.—Tarsus naked, except for the upper half, or less, of the frontal portion, roughly scaled, the smaller scutellæ being irregularly hexagonal, the larger forming a frontal and a posterior series; those behind often irregularly twisted or contorted. Toes very short, the middle one less than two-thirds the tarsus, the lateral ones shorter and equal; posterior and inner toes short and very robust, armed with powerful claws equal to or exceeding their digits in length, and outer toe very weak, with a claw less than half the length of the posterior one. Nostril broadly oval, obliquely vertical, the anterior side gradually beveled off to the edge of the cere.* Primaries very short, scarcely exceeding the greatly-developed and broad secondaries; fourth or fifth quills longest, first shortest; their inner webs very slightly sinuated, the sinuation being perceptible on the sixth, or seventh, or even the eighth quill. Tail very long, three-fourths or four-fifths the wing, even, or slightly rounded. Feathers of the occiput elongated into a conspicuous depressed crest of broad round-tipped feathers, and feathers of the neck developed into an

* It is our impression that the nostril is similarly formed in "*Spizaëtus*" *coronatus* and *S. bellicosus*; but we have no specimens for examination, and therefore cannot be positive.

erectile ruff. Contour-feathers without distinct aftershafts, but having merely a scarcely perceptible small tuft of minute fibrillæ instead.

The plumage of these birds is characterized by the broadness of the feathers, and the colors by their coarse mottlings or marblings of gray and black on the upper parts, and plain (in young) or barred (in adult) white beneath, with (in adult) or without (in young) a black pectoral area; the primaries and tail broadly banded.

The only bones of either of these genera we have been able to examine are a sternum, with the attached bones, of *Thrasaëtus*, and a very imperfect skull of *Morphnus*. The former almost exactly combines the characters of the sterna of *Aquila* and *Haliaëtus*, being much like the latter in all its outlines, the posterior margin projecting farthest back in the middle portion, and the keel very high, but the posterior outline is more distinctly sinuated, while the lateral outlines converge very rapidly anteriorly, instead of being nearly parallel for their whole length. The only resemblance to the sternum of *Aquila* (*canadensis*) is seen in the broader margin of the keel and its more distinct definition posteriorly, and in the pair of very large oval foramina near the posterior end. In size it agrees with the larger specimens of *Haliaëtus leucocephalus*, but its length is proportionally rather less. It is very different from that of *Spizaëtus ornatus*. The skull of *Morphnus* is more like that of *Aquila* than any other with which we have been able to compare it,* in nearly all the details of contour. The entire palatal surface is wanting, however, in the imperfect specimen before us, and it is probable that greater differences may exist in this portion of the skull than in the outlines.

The two genera composing the group *Morphni* may be distinguished by the following characters:—

1. THRASAËTUS.—Tail about three-fourths the wing. Tarsus less than twice the middle toe, with the frontal and posterior series of large scutellæ somewhat interrupted by occasional "dovetailing" of adjoining scales, the posterior series strongly twisted to the outside at the lower portion. Crest-plumes very broad.

2. MORPHNUS.—Tail about equal to the wing. Tarsus more than twice the middle toe, the frontal and posterior series of large scutellæ forming each a regular uninterrupted row of broad plates, that behind not twisted to the outside. Crest plumes narrow.

The *Thrasaëtus harpyia* is the most specialized form of the aquiline type, possessing in the most exaggerated degree the distinguishing features of the group.

Its distinguishing features are, abbreviated primaries and greatly-developed supernumerary secondaries; the latter, 18 in number (!), reaching to the end of the primaries. *Morphnus guianensis* comes next, with similarly naked tarsi, and the same form of wing and tail as in *Thrasaëtus*, but the crest is more like that of *Spizaëtus*, and the form also less robust. *Spizaëtus* resembles *Morphnus*, but has feathered tarsi like *Aquila*—in fact, the whole foot-structure is almost typically aquiline. The genus differs from *Aquila*, however, in short wing, occipital crest, and elongated tail. *Aquila* comes next in the series, having the foot and bill of *Spizaëtus;* but the feathering of the head is peculiar (occipital and nuchal feathers distinctly lanceolate and occiput destitute of a crest†); while the much developed rigid primaries, and shorter tail, approximate this genus more closely to the buteonine series.

* We have not been able to examine a skull of *Spizaëtus*.

† We believe the crest is present, however, in some Old World species.

MORPHNUS GUIANENSIS.

Petit Aigle de Guiane MAUDUYT, Enc. Méth. 1784, 1257.
Falco guianensis DAUD. Traité Orn. ii, 1800, 78 (ex Mauduyt), (juv.).
Morphnus guianensis CUVIER, Règ. An. i, 1817, 318.—GRAY, Gen. B. i, 1845, 15; Hand List, i, 1869, 16.—BONAP. Consp. Av. i, 1850, 30.—STRICKL. Orn. Syn. i, 1855, 24.—BURM. Th. Bras. ii, 1856, 66.—PELZ. Orn. Bras. 1871, 4, 397.—SCL. & SALV. Nom. Neotr. 1873, 120.—RIDGW. Pr. Boston Soc. 1873, 71.—SHARPE, Cat. Acc. Brit. Mus. 1874, 222.
Harpyia guianensis SWAINS. Classif. B. ii, 1837, 208.
Thrasaëtus guianensis KAUP, Mus. Senck. iii, 1845, 260.
Astur guianensis SCHLEG. Mus. Pays-Bas, Astures, 1862, 25.
Falco sonnini SHAW, Gen. Zoöl. vii, 1809, 67.
Morphnus sonnini STEPH. Gen. Zoöl. xiii, 1825, 18.
Falco delicatus SHAW, *l. c.* 1809, 67.
Spizaëtus variegatus VIEILL. Enc. Méth. iii, 1823, 1257.
Morphnus cristatus LESS. Tr. 1831, 51, t. ii, f. 2.

Hab.—Northern South America; Br. Guiana (SCHOMB.); Peruvian Andes (BARTLETT); Upper Amazon (WALLACE); New Granada (NAT. MUS.); Panama (*fide* SHARPE).

Wing, 17.50–20.25; tail, 15.00–18.00; culmen, 1.35–1.40; tarsus, 4.00–4.60; middle toe, 1.80–2.10. *Adult:*—(I.) Prevailing color brownish-black, uniform above, the lower parts everywhere transversely banded with white, the bars about 0.25 wide, and about equal in width to the black ones. Secondaries and primaries with indistinct broad bands of lighter brownish-dusky. Tail black, crossed by about five bands of mottled grayish,* and narrowly tipped with white. Upper tail-coverts tipped with white (No. 17781, ♂, Nat. Mus. Truando, New Granada; Dr. Schott). (II.) Generally similar, but head, neck, and breast uniform brownish-ash, the crest-feathers black subterminally. Beneath white, with more or less distinct and continuous bars of rufous, chiefly on the tibiæ, abdomen, and crissum. Tail with only three gray bands (exclusive of the narrower terminal one), these sometimes nearly equal in width to the black ones. (III.) Similar, but white of the lower parts without any trace of bars. *Young.*—Head, neck, and lower parts uniform white; wing-coverts finely mottled with light ash, and the whole upper surface much variegated with the same. Tail more confusedly and narrowly banded, the black and ashy bands about equal in width.

List of specimens in United States National Museum.

Catalogue-number.	Sex and age.	Locality.	From whom received.
17781	♂ ad.	New Granada (Truando)	Arthur Schott.

Other specimens examined.—In mus. Philad. Acad., 3; Boston Soc., 3; total number examined, 7.

* These bands growing gradually broader terminally.

GENUS GAMPSONYX, VIGORS.

Gampsonyx VIGORS, Zoöl. Journ. ii, 1825, p. 69. Type, *G. swainsoni* Vig.
Chondrohierax LESS. (*fide* SHARPE, Cat. Acc. Brit. Mus. 1874, 340).

CH.—Similar to *Elanus*, but much smaller, and differing in relative proportions of different parts. Colors more varied. Tail more than two-thirds as long as the wing; scales of the feet larger, the upper surface of the toes having transverse scutellæ to their bases.

This genus is very closely related to *Elanus*, so much so in fact that it may be questioned whether it is not merely subgenerically distinct, since they have so many features in common. These two genera also agree with the genus *Nauclerus* of Africa in so many points in which all three differ from other *Falconidæ* that they seem to form a very well-defined group, which may be termed the *Elani*, and which may be characterized by the following peculiar features common to the three genera.

Group ELANI.

CH.—Claws not grooved beneath, their under surface being merely flattened, or even rounded.* Two, *or none*, of the outer quills with their inner webs sinuated.† Tarsus without any transverse scutellæ, being covered nearly uniformly with small roundish or hexagonal scales. Outer toe appreciably shorter than the inner (*qu.* in *Nauclerus?*). Nostril broadly ovate, nearly horizontal, situated in the middle of the cere.

The three genera differ from each other as follows:—

A. Tomia without indentations. Tarsus about equal to, or just appreciably longer than, the middle toe; second or third quill longest outer two with inner webs sinuated near their end. Tail much shorter than the wing, double rounded.
  a. Tail less than two-thirds the wing. Scales of the feet very minute, there being transverse scutellæ only on the terminal phalanx of the toes ..... *Elanus.*
  b. Tail more than two-thirds the wing. Scales of the feet larger, the transverse scutellæ of the toes extending nearly to their base. ..... *Gampsonyx.*

B. Tomia distinctly indented. Tarsus considerably longer than the middle toe. First quill longest; *none sinuated.*‡ Tail nearly equal to the wing, excessively forked, the outer feather about twice as long as the inner, and much attenuated. Scales of the feet rough, hexagonal; transverse scutellæ only on the terminal phalanx of the toes ..... *Nauclerus.*§

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* *Pandion* is the only genus which shares this feature, but in it the claws are contracted in thickness toward the under side, which is not the case in the *Elani*, while all the claws are of equal length.

† Excepting certain *Pernes*, as *Elanoides* and *Baza*, no other *Buteoninæ* have less than three primaries with their inner webs sinuated. The *Pernes* differ from the *Elani*, however, very essentially, in their bony structure, lacking the superciliary shield or accessory piece to the lachrymal, which is simple and almost rudimentary, as in *Pandion*.

‡ The only instance, to our knowledge, in the entire family.

§ The synonymy and characters of this remarkable genus are as follows:—
Nauclerus VIGORS, Zoöl. Journ. ii, 1825, 386. Type, *Elanoides riocouri* VIEILL.
Chelictinia LESSON, 1843 (teste GRAY, ubi?). Same type.
Chelidopteryx KAUP, Mus. Senck. iii, 1845, 258. Same type.
Cypselopteryx KAUP, Weigm. Archiv, xvi, 1850, 31.
CH.—Bill much as in *Ictinia*, but less robust; nostril unusually large, oval, obliquely

GAMPSONYX SWAINSONI.

Gampsonyx swainsoni VIG. Zoöl. Journ. ii, 1825, 69; Isis, 1850, 840.—STEPH. Zoöl. xiii 1826.—LESS. Man. i, 1828, pt. 2, 36.—SWAINS. Classif. B. i, 1837, 301; ii, 210.—GRAY, Gen. 1st ed. 4; 2d ed. 5; fol. i, 1845, 26, pl. 9, fig. 4; List B. Brit. Mus. 1844, 46; Gen. & Subgen. 1855, 6; Hand List, i, 1869, 28.—CABAN. Schomb. Reis. Br. Guian. iii, 1848, 735.—BONAP. Consp. i, 1850, 21.—STRICKL. Orn. Syn. i, 1855, 137.—BURM. Th. Bras. ii, 1856, 114.—LEOT. Ois. Trinidad, 1866, 41.—SCL. & SALV. P. Z. S. 1869, 252 (Maruria, Venez.).—FINSCH, P. Z. S. 1870, p. — (Trinidad).—PELZ. Orn. Bras. 1871, 6, 398.—SCL. & SALV. Nom. Neotr. 1873, 121.—SHARPE Cat. Acc. B. M. 1874, 340.

Elanus (*Gampsonyx*) *swainsoni* RIDGWAY, Pr. Boston Soc. N. H., 1873, 54.

Elanus swainsoni KAUP, Contr. Orn. 1850, 59.—SCHL. Mus. P.-B. Milvi, 1862, 9.

Nertus rufifrons BOIE, Isis, 1828, 314.

Falco rufifrons MAX. Beitr. Orn. Bras. iii, 1830, 123.

Chondrohierax rufifrons LESS. (teste SHARPE).

Elanus torquatus LESS. Tr. 1831, 72.—PUCHER. R. Z. 1850, 14.

Wing, 5.50–6.30; tail, 3.50–4.30; culmen, 0.45–0.50; tarsus, 0.85–0.95; middle toe, 0.75–0.80. *Adult:*—Forehead and auriculars straw-yellow; lower parts white, with a yellowish wash, most pronounced on the sides where there is frequently a tinge of rufous; tibiæ, axillars, and lining of the wing ochraceous. A patch covering the crown and occiput, and surrounding the eyes, a spot on each side of the breast, with the entire upper parts brownish-black or dusky-plumbeous; nuchal collar, sides, and flanks chestnut-rufous, the former with a white one above it, below the dusky of the occiput. *Young:*—Similar, but nuchal collar entirely white, and feathers of the upper parts usually with rusty borders.

List of specimens in United States National Museum.

Catalogue-number.	Condition of specimen.	Sex and age.	Locality.	From whom received.
13684	M.	— ad.	New Granada (Savanilla).....	J. Akhurst.

Other specimens examined.—In mus. Philad. Acad., 4; Boston Soc., 3; Mus. Comp. Zoöl., 2; G. N. Lawrence, 1; total, 11.

vertical; cere very narrow and compressed on top. Tarsus considerably longer than middle toe; web between outer and middle toes just appreciable. Tarsus and toes covered uniformly with rough or granular scales of hexagonal or nearly square form; only the terminal joint of the toes with transverse scutellæ; claws rounded beneath. Wing very long, swallow-like, the first primary much the longest, and none sinuated on either web. Tail tern-like, nearly equal to wing, forked to about one-half its length, the outer feathers much attenuated. Colors, ashy above, white beneath.

GENUS LEPTODON, SUNDEVALL.

Cymindis CUVIER, Règ. An. i, 1817, 319. Type, *Falco cayennensis* GMEL. (Not of LATR. 1806.)
Leptodon SUNDEVALL, K. Vet. Akad. Handl. 1835, 114. Same type.
Odontriorchis KAUP, Mus. Senck. iii, 1845, 262. Same type.

CH.—Bill strong, swollen laterally, much hooked, the upper outline of the cere gradually ascending, and moderately arched; superior tomium with a more or less distinct tooth behind the strong, but rather short, hooked tip. Membrane of the cere somewhat tumid, the nostril narrow, oblique, slit-like, nearly covered by a tumid membrane, and touching the anterior edge of the cere. Lores and eyelids naked, but uniformly bristled. Feet small but robust, the tarsus about equal to the middle toe. Top of the toes with regular transverse scutellæ; tarsus covered with rather large hexagonal scales. Claws rather small, very broad, and slightly hollowed beneath, the edges sharp and prominent. Feathers of the crown and occiput distinct, rather lengthened, nearly cuneate, but with rounded tips. Secondaries much developed, reaching nearly to the end of the primaries. Third to fifth quill longest; first shorter than seventh, sometimes shorter than the ninth. Inner webs of outer four to six very slightly sinuated. Tail lengthened, about two-thirds as long as the wing, rounded, the feathers very broad.

This subgenus is so very similar to *Aricida* that there is considerable doubt as to the propriety of separating the two; the only difference is in the proportionate development of the primaries and secondaries, in the slightly more rounded tail, and in the less developed crest and larger size of *Leptodon*. These two genera, along with *Baza*, *Pernis*, and *Regerhinus*, form a most natural group, which may be termed the *Pernes*, and to which we are doubtfully inclined to refer the genus *Elanoides* as an aberrant member.

This group may be characterized as follows:—

Group PERNES.

CH.—Superciliary process of the lachrymal simple and much abbreviated, as in *Pandion*, but (as in the *Polybori*) not anchylosed with the frontal bone. Outer toe not reversible, and the claws normal (*i. e.* graduated in size, and flattened, or slightly concave beneath). Feet small, the tarsus very short, scarcely exceeding the middle toe; outer and middle toes not united at the base by a membrane. Tarsus covered with irregular, usually hexagonal, scales—never scutellate; middle claw with its inner edge much produced, convex, sharp, sometimes with rudimentary pectinations. Plumage soft, full; sides of the head densly feathered close up to the eyelids, the eyes prominent, and not protected by a superciliary shield.

The more strongly-marked genera of the group may be characterized as follows:—

A. Cere tumid, the nostril slit-like, overhung by a soft membrane. Tail even or rounded, much shorter than the wing. Inner webs of outer two to six primaries with inner webs sinuated; third to fifth quill longest; first shorter than seventh.

a. Bill only moderately hooked and not conspicuously compressed. Feathers of the pileum rather firm, distinctly defined; several of those on the occiput more elongated, forming more or less of a crest.

Loral feathers very compact, imbricated, and without bristly tips. Tomia not toothed.....*Pernis.*

Loral feathers moderately compact, or even scattered, not imbricated, and with bristly tips. Tomia toothed.

§. Four outer primaries with inner webs sinuated....*Leptodon.*

§. Two outer primaries with inner webs sinuated.....*Baza.*

b. Bill greatly hooked, and much compressed. Feathers of the pileum soft and blended, without tendency to greater elongation on the occiput. Lores naked, crossed by a narrow line of fine bristles from the anterior angle of the eye to the forehead .....*Regerhinus.*

B. Cere not tumid, the nostril broady oval, without overhanging membrane. Tail excessively forked, about equal to the wing. Inner webs of only two outer quills sinuated. Tomia without indentations. Lores densely feathered.....*Elanoides.*

The transition from *Leptodon* to *Baza*, through *Avicida*, may be expressed by the following tabulation of the main characters of the three genera:

A. Five outer primaries with inner webs sinuated.

a. Tail much rounded. Primaries but little longer than secondaries. Lores scantily feathered. Indentations of the tomia a simple tooth and notch. Occipital crest rudimentary.....*Leptodon.*

b. Tail nearly even. Primaries considerably longer than the secondaries. Lores scantily or compactly feathered. Indentations of the tomia simple or double. Occipital crest rudimentary or moderately developed.....*Avicida.**

B. Two outer primaries with their inner webs sinuated. Loral feathers very compact. Indentations of the tomia double. Occipital crest very long.....*Baza.*

The apparently wide difference between *Leptodon* and *Pernis* in the feathering of the lores is most perfectly made up by the varying character of the species in the genus (or subgenus) *Avicida*, the three species we have been able to examine varying as follows:—

A. subcristata.—Loral feathers compact. Indentations of the tomia double.

A. verreauxi.—Loral feathers scant. Indentations of the tomia double.

A. cuculoides.—Loral feathers scant. Indentations of the tomia simple.

Thus, in *A. subcristata*, the loral feathers are only a little less compact than in *Baza*, in which they are rather less dense than in *Pernis*. In the other two species they are still less dense, though more so than in *Leptodon* (as most restricted); while one of the species of *Avicida* agrees with *Leptodon* in the simple indentations of the tomia. Nearly all of these birds, including *Pernis*, have more or less of a tendency in a few of the occipital feathers to form a crest, which in *Leptodon* is constantly rudimentary, and in the species of *Avicida* and *Pernis* frequently so.

LEPTODON CAYENNENSIS.

Falco cayennensis GMELIN, Syst. Nat. i, 1788, 269 (not of p. 263!), (adult).—LATH. Index Orn. i, 1790, 28; Gen. Hist. i, 1824, 269.—DAUD. Tr. Orn. ii, 1800, 74.—SHAW, Zoöl. vii, 161.—TEMM. Pl. Col. i, 1824, pl. 270; Tab. Méth. 4.

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*Avicida SWAINSON, Birds W. Africa, i, 1837, 104. Type, *A. cuculoides* SWAINS.

This genus includes also *A. subcristatus* (Gould) and *A. verreauxi* Lafr., and probably others, since Mr. Sharpe includes in the genus "*Baza*" ten species, of which we cannot state positively that more than one, *B. lophotes*, is a true *Baza*, not having seen most of the species described.

Cymindis cayennensis CUVIER, Règ. An. i, 1817, 319; *ib.* ed. 2, 331.—VIG. Zoöl. Journ. i, 182–, 323, 337.—STEPHENS, Zoöl. xiii, pt. 2, 18—, 18.—LESSON, Man. i, 1828, 91; Tr. Orn. 1831, 55, pl. 13, fig. 2.—LAFRESN. Mag. Zoöl. pl. 22.—KAUP, Class. Säug. u. Vög. 1844, 123.—GRAY, Gen. B. 1845, 25; Hand List, i, 1869, 27.—BONAP. Consp. Av. i, 1850, 20.—V. D. HOEV. Handb. Dierk. 1855, 809.—STRICKL. Orn. Syn. i, 1855, 128.—BURM. Th. Bras. ii, 1856, 107.—LAWR. Ann. Lyc. N. Y. 1861, p. — (New Granada); *ib.* 1868, 134 (Gulf of Nicoya, Costa Rica).—SCHLEG. Mus. Pays-Bas, Pernes, 1862, 9; Rev. Acc. 1873, 136.—LÉOT. Ois. Trinidad, 1866, 34.—SCLATER, P. Z. S. 1868, 629 (Venezuela).—SCL. & SALV. P. Z. S. 1870, 215 (Veragua); *ib.* 838, (coast Honduras); Nom. Neotr. 1873, 122.—FINSCH, P. Z. S. 1870, p. — (Trinidad).—PELZ. Orn. Bras. 1871, 5, 398.—RIDGW. Pr. Bost. Soc. N. H. 1873, 53.

Astur cayennensis SPIX, Av. Bras. i, 1824, pl. 8c.

Buteo cayennensis LESS. Man. Orn. i, 1828, 103.

Odontriorchis cayennensis KAUP, Class. Säug. u. Vög. 1844, 124; Contr. Orn. 1850, 78.

Leptodon cayennensis SHARPE, Cat. Acc. B. M. 1874, 333.

Asturina cyanopus VIEILL. Enc. Méth. iii, 1823, 1261.

Falco palliatus MAX. in Temm. Pl. Col. i, 1823, pl. 204 (juv.); Beitr. iii, 1830, 148.

Buteo palliatus LESS. Man. Orn. i, 1828, 103.

Cymindis buteonides LESS. Tr. Orn. 1831, 55.

Cayenne Falcon LATH. Syn. i, 1781, 59.

Petit Autour de Cayenne BUFF. Pl. Enl. i, 473.

Hab.—Tropical America, on the Atlantic side, from Brazil to Mirador, Mexico. West Indies? (SHARPE).

Wing, 11.25–13.00; tail, 9.70–10.50; culmen, 0.80–1.05; tarsus, 1.40–1.75; middle toe, 1.50–1.75. Fourth, fifth, or sixth quill longest; first shorter than the ninth. Lower parts usually entirely white, but sometimes with narrow dusky streaks on the breast and sides, and occasionally (in melanistic young birds) with broad stripes or longitudinal spots of blackish over entire lower surface. Above plain plumbeous, plumbeous-black, brownish-black or blackish-brown (the latter color usually in the younger stage and variegated with ochraceous,) the head usually lighter (generally pale ash-gray or pure white), but sometimes (in those individuals which are heavily striped beneath) almost wholly black. Tail broadly banded with black and gray or black and brown. *Adult:*—Above very dark bluish-plumbeous, approaching black anteriorly, with a faint reflection of bottle-green in certain lights; remiges indistinctly banded with lighter plumbeous. Head and neck plain fine bluish-plumbeous or pearl-gray, darker on the pileum and fading into white on the throat. Beneath entirely immaculate pure white. Tail deep black, narrowly tipped with white, and crossed by three rather narrow bands of bluish-gray. *Young.—Light phase:*—Above dusky brown, approaching black anteriorly, the remiges indistinctly banded with dusky. Head and neck usually almost wholly pure white, the pileum more or less spotted with blackish-brown. Lower parts white. Tail brownish-gray or brownish-white, crossed by three bands of black.* *Dark phase (Melanistic?):*—Upper parts as in the last, but lower parts striped more or less broadly with blackish, and the head and neck (except the throat) uniform blackish like the back.

A young specimen from Panama in Mr. Lawrence's collection, agreeing with stage III of the above diagnosis, calls to mind Temminck's Pl. Col. 270; but it is not so dark beneath as the plate referred to, has no rufous on the nape, and has white streaks on the throat.

*Another phase (younger?) is similar, but the lesser wing-coverts are much mixed with white, and all the feathers of the upper parts are tipped with pale buff or fulvous. The black bands of the tail only about half as wide as the interspaces, and the head pure white, with only a few touches of dusky on the occiput.

List of specimens in United States National Museum.

Catalogue No.	Original No.	Sex and age.	Locality.	Date.	From whom received.
32973	42630	.....	Amazonia	.....	Verreaux.
33533	145	.....	Mirador, East Mexico	Oct. —, 1864	Dr. C. Sartorius.
44730	310	.....	do	.....	Do.
64932	636	♂ ad.	Costa Rica	.....	Prof. W. M. Gabb.
66332	.....	♂ ad.	Costa Rica (Old Harbor)	.....	Do.
67280	56	♀ ad.	Tehuantepec	Feb. 13, 1872	Prof. F. Sumichrast.
67859	255	♀ ad.	Costa Rica (Talamanca)	.....	Prof. Gabb.

Other specimens examined.—In mus. Philad. Acad., 7; Am. Mus., N. Y., 1; Boston Soc., 4; Mus. Comp. Zoöl., 1; G. N. Lawrence, 2; other specimens, 2; total, 24.

The sexes compare in measurements as follows:—

Sex.	Wing.	Tail.	Culmen.	Tarsus.	Middle toe.	No. specimens.
♂	11.90–12.50	9.80–10.00	1.00	1.40–1.55	1.50–1.60	3
♀	11.25–13.75	9.80–11.00	1.00–1.05	1.50–1.70	1.50–1.60	5

"Iris dark purplish-gray or brownish-plumbeous; cere, orbits, lores, and feet light ashy-blue or dirty grayish-white."—(SUMICHRAST, MSS. on labels.)

GENUS REGERHINUS, KAUP.

Regerhinus KAUP, Mus. Senck. iii, 1845, 262. Type, *Falco uncinatus* ILLIG.
Cymindis SWAINS. 1837, et AUCT. (nec. CUV. 1817).

CH.*—Form very light; the feet very weak (almost Steatornithine); bill very large, greatly hooked, and much compressed; wings and tail large, the latter slightly rounded. Tomia without indentations or perceptible sinuations; gonys nearly straight; tomium of the lower mandible very convex. Nostril very small, slit-like, narrower, and more horizontal than in *Leptodon*. Tarsus about equal to the middle toe, covered with large, irregular, hexagonal scutellæ (as in *Leptodon* and *Elanoides*); toes and claws compressed; middle claw with its inner edge much produced, as in *Elanoides*. Remiges and rectrices greatly developed, very broad, and of a soft texture. Contour-feathers of the inferior surface remarkably broad, their tips nearly truncated; feathers of the pileum soft and blended, with no tendency to an occipital crest. Secondaries very long and broad, about three-fourths as long as the primaries; third, fourth, or fifth quills longest; first shortest; outer six with inner webs faintly sinuated. Tail large, but much shorter than the wing, slightly rounded, the feathers broad and soft. Lore wholly naked, with a narrow strip of bristles extending from the anterior angle of the eye to the anterior part of the frontal feathers, which extend forward so as to almost cover the top of the cere. After-shafts better developed than in *Leptodon*.

This genus is so very distinct from *Leptodon* that it is a matter of surprise why it should ever have been considered synonymous. The form of the bill is entirely different and strikingly distinctive, while there are very conspicuous differences throughout its external structure. The feet are weaker than in any of the allied genera, the toes and claws being more compressed. In its pterylosis, it is more like *Avicida subcristata* than any other species of the group, the contour-feathers of the lower surface having that same remarkable breadth and nearly truncated termination, while the wings and tail are quite similar. There is also considerable resemblance in the colors and markings. In *Avicida*, however, the lore is feathered, the occipital feathers are pointed and crest-like, and the bill more like that of *Leptodon*.

The species of this genus present so many phases of plumage that they are in a state of great confusion. We do not pretend to have made any progress toward elucidating them, but present our views so far as they have resulted from the examination of the material available.

REGERHINUS UNCINATUS.

Falco uncinatus TEMM. Pl. Col. 1824, pls. 103, 104, 115.
Cymindis uncinatus LESSON, Man. Orn. i, 1828, 91; Tr. Orn. 1831, 55.—VIG. Zoöl. Journ. i, 337.—STEPHENS, Zoöl. xiii, 22.—GRAY, Gen. B. 1845, 25, pl. 9, fig. 7; Hand List, i, 1869, 136.—KAUP, Class. Säug. u. Vög. 1844, 124.—BONAP. Consp. Av. i, 1850, 21.—BURM. Th. Bras. ii, 1856, 108.—SCL. & SALV. P. Z. S. 1864, 369 (Isth. Panama); Nom. Neotr. 1873, 122.—LÉOT. Ois. Trinidad, 1866, 36.—LAWR. Ann. Lyc. N. Y. ix, 1868, 134 (San José, Costa Rica).—FINSCH, P. Z. 1870, 557 (Trinidad).—S. PELZ. Orn. Bras. 1871, 5, 398.—SCHLEG. Rev. Acc. 1873, 136.—SHARPE, P. Z. S. 1873, 419.

* I have been unable to obtain bones of this genus, but the osteological characters are probably very similar to those of *Leptodon* and *Elanoides*. Nitzsch mentions nothing peculiar in the pterylosis.

Regerhinus uncinatus KAUP, Mus. Senck. 1845, 232; in Jard. Contr. Orn. 1850, 77.—R. SCHOMB. Reise Guiana, 1848, 736.
Rostrhamus uncinatus STRICKL. Orn. Syn. i, 1855, 136.
Leptodon uncinatus SHARPE, Cat. Acc. B. M. 1874, 330.
Falco vitticaudus MAX. Beitr. iii, 1830, 178.
Cymindis vitticaudus PELZ. Orn. Bras. 1871, 6, 398.
Cymindis cuculoides SWAINS. Class. B. i, 1837, 311; ii, 209.
? *Cymindis pucherani* LÉOT. Ois. Trinid. 1866, 40.—GRAY, Hand List, i, 1869, 25.—FINSCH, P. Z. S. 1870, 557.
? *Cymindis boliviensis* BURM. P. Z. S. 1868, 635.—GRAY, Hand List, i, 1869, 28.
Cymindis (*Regerhinus*) *boliviensis* GRAY, Hand List, i, 1869, 28, No. 257.

Culmen forming a curve of one-fourth to one-third the circumference of a circle; horizontal diameter of the upper mandible considerably greater through the tomia than nearer the culmen. Wing, 10.70–12.25; tail, 8.00–9.00; culmen, 1.00–1.45; tarsus, 1.40–1.50; middle toe, 1.15–1.25. Fourth to fifth quills longest; first shortest.

a. Light phase.

Adult:—(I.) Uniform dark plumbeous or plumbeous-black, the occiput with much basal white; tail deeper black, narrowly tipped with white or ash, and crossed about the middle by a broad zone of white, this sometimes tinged with ash.* (II.) Similar, but paler plumbeous beneath, the crissum pale ochraceous or ochraceous-white (sometimes with distant bars), and the entire lower surface barred narrowly with white Primaries with distant indistinct bands of black, especially on inner webs. Upper tail-coverts tipped and barred with pale ash or white. Tail with an additional narrower band at the end of the upper coverts,† the light bars (which are more or less tinged with ash) passing into pale cream-color or white on the webs. Inner webs of the primaries sometimes banded (about equally) with white and plumbeous.‡ *Young:*—(III.) Above blackish-brown or brownish-plumbeous, approaching black anteriorly, and interrupted by a broad and continuous nuchal collar of deep ochraceous or bright rufous. Tail with three about equal zones of black and grayish, and narrowly tipped with the latter. Auriculars and forehead bluish-ashy; pileum like the back. Beneath white or ochraceous-white (more ochraceous on the crissum), with broad nearly equal transverse bars of ferruginous over the whole surface, except sometimes on the crissum. Inner webs of primaries white, distantly banded with black. Inner primaries tinged with rufous. (IV.) *Younger?:*—Generally similar, but feathers of upper parts more or less bordered with rufous; secondaries, tertails, and primaries narrowly tipped with white or ochraceous, and very obscurely banded with darker. Nuchal collar white and sometimes badly defined. Tail crossed with four nearly equal bands of black and grayish, and narrowly tipped with white. Auriculars and forehead blackish-brown, like the back and pileum. Lower parts barred with dark umber instead of rufous, the bars sometimes almost wholly absent.§ (V.) *Youngest?:*—Similar to the last, but the rufous borders to the feathers of the upper parts broader, very conspicuous on the tertials, secondaries, and primaries. Auriculars and broad nuchal collar pale ochraceous. Beneath distantly and irregularly barred with ferruginous over the whole surface except the throat.

*Occasionally, as in No. 30541, "North Coast Central America," and a Guatemalan skin in Mr. Lawrence's collection, there is another narrower band anterior to this, just at the end of the upper coverts, or concealed by them.

†The tail-pattern of this stage is that seen in occasional individuals in the more uniformly plumbeous dress, noticed above.

‡Specimens of this plumage retain traces of stage III.

§Some examples of this stage retain traces of stage V.

b. Melanistic phase.

Adult ♂ (VI): Uniform brownish black. Tail deep black, narrowly tipped with white, and crossed by two bands of gray, which change to white or cream-color on the inner webs (=*C. boliviensis* BURM. and *C. pucherani* LÉOT.). *Young* (VII): Similar to the above, but the feathers of the upper surface with narrow terminal margines of rusty, and those of the crissum with white tips.

The black plumage described above, and upon which *Cymindis boliviensis* of Burmeister and *C. pucherani* of Léotaud were based, is almost certainly merely a melanism of the common *R. uncinatus*. We have seen two specimens—an adult in the museum of the Boston Society of Natural History and a young female in the American Musum of New York. They agree entirely with Burmeister's description referred to above, which is as follows:—

DIAG.—"*C. fusco-nigra, remigibus rectricibusque subtus albo-fasciatis; cera pedibusque croceis; long* 18″.

"We have of this species one specimen in our museum, which was killed near Santa Cruz de la Sierra, in the woody plains of the interior of Bolivia. As I can find no description of this bird in the works fallen under my inspection, I describe it as a new species.

"In size and figure, entirely like the common Brazilian species *Cym. uncinata*. The bill not stronger, and of the same form, but rather longer; the upper mandible black, the lower mandible whitish. The sides of the face, from the beak to the eyes, naked, with some black bristles in a row from the eye to the nostrils. Iris dark brown. The whole plumage blackish-brown, but the bases of the feathers of the vertex from the front to the occiput white; the nuchal feathers elongated, broad, rounded. First primary short, not longer than the secondaries; the second somewhat longer than the fifth; the third somewhat longer than the same; and the fourth the longest of all; every one with four or five white bands on the inside, of which the exterior is somewhat grayish. Secondaries of nearly equal size, every one with five or six whitish bands on the inside, which are only clear white in the middle of the plume. Tail only two inches longer than the wings in position, black, with two large gray bands on the upper side, and the same white on the under side, and a similar margin at the ends of the rectrices. Legs yellow, with black claws, the outer toe the same length as the inner; the tarsus covered in front with small hexagonal scales.

"Whole length, from the tip of the beak to the end of the tail, 18 inches; beak, 1 inch; wing, 10 inches; tail, 7 inches; tarsus, 1½ inch; middle claw [toe] without the nail, 14 lines, the nail, 8 lines."

With Burmeister's description of his *Cymindis boliviensis*, as quoted above, a specimen in the collection of the Boston Society of Natural History;* while another in the New York Museum agrees very closely but has the feathers of the upper surface narrowly bordered terminally with rusty, and the lower tail-coverts with white. Tail deep black, narrowly tipped with white, and crossed by two zones of gray, which change to white or cream-color on the inner webs. The specimen in the New York Museum is marked "♀ *juv.* Brazil", and, judging from the rusty borders to the feathers, is undoubtedly an immature bird. The other specimen is marked simply "South America".

* This specimen is No. 1411 on p. 53 of "Catalogue of the Falconidæ in the museum of the Society" (Proceedings, May 21, 1873).

List of specimens in United States National Museum.

Catalogue No.	Original No.	Sex and age.	Locality.	From whom received.
30541	.....	— ad.	Central America	Captain J. M. Dow.
33208	160	— ad.	Costa Rica	Dr. A. von Frantzius.
34605	.....	— juv.	Panama	J. H. Reeves.

Other specimens examined.—In mus. Philad. Acad., 9; Am. Mus., N. Y., 6; Boston Soc., 6; G. N. Lawrence, 5; total, 29.

REGERHINUS WILSONI.

Cymindis wilsonii CASS. Journ. Ac. N. S. Philad. n. ser. i, 1847, 21, pl. 7.—GRAY, Gen. B. fol. App. 2; Hand List, i, 1869, 28.—BONAP. Consp. 1850, 21.—STRICKL. Orn. Syn. i, 1855, 129.—LAWR. Ann. Lyc. N. Y. vii, 1860, 257.—SCL. & SALV. Nom. Neotrop. 1873, 122.

Regerhinus wilsonii KAUP, Arch. f. Naturg. 1850, 40.—BREWER, Pr. Boston Soc. N. H. 1860, 305.—GUNDL. Journ. f. O. 1872, 360.

Leptodon wilsoni SHARPE, Cat. Acc. Brit. Mus. 1874, 333.

Regerhinus uncinatus CABAN. Journ. f. Orn. 1854, lxxx (not of Temm.).

Cymindis uncinatus BREWER, Pr. Boston Soc. N. H. 1860, 305.

Hab.—Cuba.

Culmen forming a curve of nearly one-half the circumference of a circle; horizontal diameter of the upper mandible scarcely greater through the tomia than near the culmen. Wing, 9.70–10.50; tail, 7.50–8.00; culmen, 1.50; tarsus, 1.15–1.25; middle toe, 1.05–1.10. Fifth quill longest; first about equal to the tenth. *Adult:*—Above, including nape and head all round, bluish-slate, paler and more bluish-ashy on cephalic portions; primaries darker. Tail black, crossed by four light bands, the two anterior ones white, the others light ash-gray, the subterminal one much the widest, the terminal one about equal to the others. Beneath white, barred everywhere, except on the crissum, with pale gray anteriorly and umber posteriorly, these bars nearly as wide as the white interspaces. Crissum with the longer feathers narrowly and distantly barred. Under surface of the primaries plain white, anterior to their sinuation the terminal portion ashy, with about three distant bands, those on the white being dilute rufous, and those on the gray blackish. *Young:*—(I.) Above umber, more or less tinged with ferruginous on the wings, the inner primaries being mostly of this color. Tail brownish-gray, crossed by three distant bands of blackish, these broader and more distinct terminally, the tip being quite broadly and regularly of the ground-color. Near the base are two to three more or less distinct narrow and interrupted bands of white. Lower parts, including a collar round the nape, white, the whole surface broadly (more narrowly on the neck, all round, and on the lining of the wing) barred with ferruginous. II. (*very young*):—Above brownish-gray, the feathers bordered terminally with pale rusty; remiges indistinctly banded with darker. Tail ash-gray, becoming gradually white at the extreme base, narrowly tipped with the same, and crossed by six narrow bands of dull black. Head plain pale ashy, becoming gradually white on the throat. Beneath white, distinctly barred, except on the crissum, with narrow lunules of brown.

List of specimens in United States National Museum.

Catalogue No.	Sex and age.	Locality.	From whom received.
23550	♂ juv.	Monte Verde, Cuba	Charles Wright.

Other specimens examined.—In Mus. Philad. Acad., 2.

REGERHINUS MEGARHYNCHUS.

Regerhinus megarhynchus DES MURS, Casteln. Voy. Zool. Ois. 1855, 9, pl. 1.
Cymindis megarhynchus GRAY, Hand List, i, 1869, 28.—SCL. & SALV. Nom. Neotrop. 1873, 122.
Leptodon megarhynchus SHARPE, Cat. Acc. Br. Mus. 1874, 332.

Hab.—Peru and Bolivia (Sharpe).

"*Nearly adult.*—Above slaty blue. Clearer on the head and darker on the back; wing-coverts brown, margined with deep ocher (evidently the remains of young plumage); quills brown, shaded externally with ashy, the secondaries clearer brown, with rufous-white tips; under surface of wings white at base, greyish-white for the apical half, all the quills barred above and below with dark brown; lower back, rump, and upper tail-coverts blackish-brown, the latter barred near the base and tipped with white; tail alternately banded with black and ashy-brown, and tipped with white, the black bands being much the broadest, and between them and the ashy bands a faint indication of a white line; throat slaty-blue, like the sides of the face; rest of the under surface slaty-blue, banded narrowly with white; under wing- and tail-coverts white, with only a few nearly obsolete indications of narrow brownish cross-bars; bill dark horn-black, yellowish on under mandible; feet deep yellow, nails black. Total length 19 inches, culmen 2.5, wing 12.3, tail 9.2, tarsus 1.6."—(SHARPE, *l. c.*)

This species we have not seen. It is apparently more like *R. wilsoni* than *R. uncinatus*, but is evidently very distinct from both.

GENUS ANTENOR, RIDGWAY.

'*Craxirex* GOULD", CASSIN, Birds N. Am. 1858, 46, et AUCT. (not of GOULD, 1841).
Antenor RIDGWAY, Proc. Boston Soc. Nat. Hist. May, 1873, 63. Type, *Falco unicinctus* TEMM.
"*Parabuteo* RIDGWAY", B. B. & R. Hist. N. Am. Birds, iii, Jan. 1874, 248. Same type.*
Erythrocnema SHARPE, Cat. Acc. Brit. Mus. July, 1874, 84. Same type.

CH.—Similar to *Buteo*, but five, instead of three or four, outer primaries, with inner webs emarginated. Bill as in *Buteo*, but superior tomium rather more distinctly lobed, and upper outline rather more ascending basally. Tarsus about twice the length of the middle toe; outer toe slightly longer than the inner, which very slightly exceeds the posterior toe; claws strong, well curved, typically buteonine, the posterior equal to or longer than its digit; scutellation typically buteonine; number of transverse plates in front varying from 11 to 12; upper portion of the tarsus feathered in front for nearly half its length. Wing moderately long, the third, fourth, or fifth quills longest; first shorter than the eighth; outer five with their inner webs emarginated, the cutting being very indistinct, however, on the fifth. Tail long, about two-thirds the wing, even, or very slightly rounded. Lore very scantily feathered, the bristles being very fine and scattered.

The more closely we have examined this form, the more difficult it has become to appreciate *constant* characters separating it from *Buteo*, with the more compactly built members of which, as *B. borealis* and its allies, it agrees very closely in the details of external form. The main differences consist in the longer tail, more scantily-bristled lores, and the emargination of the fifth primary. It is far less closely related to *Urubitinga*, though we had previously hinted at such a relationship, the latter genus differing in much shorter, more rounded wing, with the inner webs of the primaries very shallowly sinuated. To *Astur*, it is far more remotely allied, the osteological as well as external differences being very striking.

The cranium of *Antenor* is very similar to that of *Buteo borealis*, the details of structure being exactly the same, the only differences being slight ones of contour. Its upper portion is more depressed, presenting in this respect a closer resemblance to that of *Asturina*.

ANTENOR UNICINCTUS.

a. unicinctus, Temminck.

Falco unicinctus TEMM. Pl. Col. i, 1824, pl. 313.
Morphnus unicinctus LESS. Man. i, 1828, 90.
Astur unicinctus CUV. Règ. An. i, 1829, 322.—GRAY, Gen. i, 1849, 27.—KAUP, Contr. Orn. 1850, 66.—STRICKL. Orn. Syn. i, 1855, 221 (in part).
Nisus unicinctus LESS. Traité, 1831, 61.
Buteo unicinctus GRAY, List Acc. B. M. 1844, 18; Hand List, i, 1869, 7.
Hypomorphnus unicinctus CABAN. Arch. f. Naturg. 1844, 263; Faun. Per. 1844, 17, 85.
Spizageranus unicinctus KAUP, Mus. Senck. iii, 1845, 260.—SCL. P. Z. S. 1860, 288.
Craxirex unicinctus BONAP. Rev. et Mag. Zool. 1854, 537.—ORTON, Am. Nat. 1871, 624 (Quito Valley).
Asturina unicincta BURM. Th. Bras. ii, 1855, 82; Reis. La Plata-St. ii, 1861, 436.—SCHL. Mus. P.-B. Asturinæ, 1862, 2.
Urubitinga unicincta LAFR. R. Z. 1849, 99.—SCL. P. Z. S. 1858. 150.—PELZ. Orn. Bras. i, 1868, 3, No. 10; iv, 1871, 2, 394.—SCL. & SALV. P. Z. S. 1868, 143 (Buenos Ayres); *ib.* 175, 570 (Peru); Nom. Neotr. 1873, 119 (part).

* The publication of this name was the result of an unfortunate oversight of the printers in correcting from the last revised proof-sheets.—R. R.

Urubitinga (*Antenor*) *unicincta* RIDGW. Pr. Boston Soc. N. H. May, 1873, 93.
Parabuteo unicinctus RIDGW. B. B. & R. Hist. N. Am. B. iii, 1874, 249, 250.
Erythrocnema unicincta SHARPE, Cat. Acc. B. M. 1874, 85.
Polyborus tæniurus TSCHUDI, Arch. f. Naturg. 1844, 263; Fauna Per. 1844, pl. 1.

Hab.—South America generally, south to Chili and Buenos Ayres.

β. harrisi, Aud.

Falco harrisii AUD. B. Am. 1831, pl. cccxcii; Orn. Biog. v, 1849, 30.
Buteo harrisii BONAP. Comp. List, 1838, 3.—AUD. Synop. 1839, 5.—DE KAY Zool. N. Y. ii, 1844, 11.
Craxirex harrisii COUES, Pr. A. N. S. Phil. 1866, 49.—COOPER, Orn. Cal. i, 1870, 493.
Buteo unicinctus var. *harrisii* RIDGW. Coues' Key, 1872, 215.—COUES, Check List N. Am. B. 1873, 69, No. 348.—LAWR. Mem. Boston Soc. N. H. ii, 1874, 302 (N. W. Mexico).
Antenor unicinctus var. *harrisi* RIDGW. B. B. & R. Hist. N. Am. B. iii, 1874, 250.
Parabuteo unicinctus var. *harrisi* RIDGW. B. B. & R. Hist. N. Am. B. iii, 1874, 250.
Craxirex unicinctus CASS. B. N. Am. 1858, 46 (not of Bonap. 1854, ex Temm. 1820).—BAIRD, Cat. N. Am. B. 1859, No. 46.—DRESSER, Ibis, 1865, 329.—COUES, Pr. A. N. S. Phil. 1866, 13.—SALVIN, P. Z. S. 1867, 158 (Veragua).
Erythrocnema unicincta SHARPE, Cat. Acc. B. M. 1874, 85 (in part).

Hab.—Middle America, from the southern border of the United States (Louisiana to Lower California) south to Panama (?).

Wing, 11.65–14.60; tail, 9.00–11.00; culmen, 0.82–1.10; tarsus, 2.78–3.75; middle toe, 1.52–2.00. *Adult:*—General color brownish-black or blackish-brown, uniform or slightly variegated by light spotting; the lesser wing-coverts and tibiæ deep rufous or chestnut. Tail black; the end and base white, as are also the tail-coverts. *Young:*—Plumage greatly variegated. Above blackish-brown, the feathers edged with rusty; head and neck streaked with pale ochraceous. Lower parts pale ochraceous or yellowish-white, the breast and abdomen with longitudinal ovoid spots of blackish; tibiæ with transverse bars of dark rusty; lower tail-coverts with black shaft-streaks. Lesser wing-covert region only washed with rufous. Tail grayish-brown, whitish at the tip, and crossed by narrow bands of dusky.

a. unicinctus.

Adult with the blackish more or less broken up by lighter spotting or streaking; tibiæ barred rufous and ochraceous. Wing, 11.65–14.60; tail, 9.00–10.50; culmen, 0.82–1.02; tarsus, 2.78–3.40; middle toe, 1.52–1.85. *Adult* (?) *female* (No. 48814, Santiago, Chile):—Prevailing color brownish-black, broken by white streaks on the cheeks and throat, white borders and concealed spots on the abdomen, and ochraceous edges to feathers of the central portion of the breast. Remiges with a narrow terminal border of white. Wing-coverts mostly deep ferruginous-rufous, nearly uniform and almost chestnut in tint on the lesser coverts, which have dusky shaft-streaks, but much broken by a dusky spotting on the middle and greater coverts, where the central portion of each feather is uniform blackish. Lining of the wing mostly ferruginous, but this broken by white and dusky spotting. Tibiæ ochraceous, irregularly barred with rusty-rufous, these bars suffused into a nearly continuous wash of the latter color on the outer surface. Upper tail-coverts and crissum immaculate white. Tail uniform black, the extreme base and a sharply-defined terminal band, about one inch broad, pure white; the inner webs of the feathers more or less mottled with grayish-brown, the white at the base extending farther from the roots of the feathers. Inner webs of primaries white anterior to their emargination, relieved by indications of dusky bars, the remaining portion grayish-dusky, with irregular or broken blackish bars. *Young* (No.

48815, ♀, Santiago, Chile):—Above chiefly brownish-black, but this broken by a reddish-fulvous streaking on the head, neck, and back, and by a coarse irregular spotting of the same on the greater wing-coverts; all other feathers more or less tipped or margined with the same. Remiges dusky grayish-brown, with indistinct narrow bars of dusky. Upper tail-coverts immaculate white. Tail dusky grayish-brown, the extreme base pure white, and the tip fulvous-white, crossed by very numerous (about nineteen) narrow indistinct bars of dusky; their inner webs more whitish, with the bars better defined. Lower parts ochraceous, the throat, jugulum, breast, sides, and abdomen with longitudinally ovate or tear-shaped spots of brownish-black, largest on the breast. Tibiæ marked with faint, small, and irregular bars of brown. Crissum immaculate white.

An adult from Guayaquil (No. 54935) has the blackish more continuous, but still conspicuously streaked with white on the throat; the tibiæ are pale ochraceous, thickly barred with rusty; the terminal band of the tail is less than an inch wide, and is tinged with gray. Nos. 13907, female, and 13908, male, from Chile, differ in having the black much broken, both above and below, but chiefly on the lower surface, with white spottings and streaks; the throat and cheeks white, streaked with dusky. These two specimens correspond quite closely with Temminck's plate of the adult.

β. harrisi.

Adult with the blackish continuous and uniform. Wing, 12.35–14.50; tail, 9.80–11.00; culmen, 0.90–1.10; tarsus, 3.15–3.75; middle toe, 1.65–2.00. *Adult female* (No. 12230, Cape St. Lucas, Lower California):—Prevailing color uniform sooty-black, deepest on the tail, the rump somewhat tinged with chestnut. Lesser wing-coverts, lining of the wing, and the tibiæ plain, unbroken, rich chestnut-rufous, middle wing-coverts similar, the middle portion of each feather blackish; greater coverts of the under side with black shaft-streaks. *Under surface of primaries* (inner webs) *plain sooty-black.* Upper tail-coverts and crissum pure white, the former with blackish shaft-streaks Tail deep black, the extreme base and a broad terminal band pure white. Wing, 14.50; tail, 10.00; tarsus, 3.25; middle toe, 2.00. [No. 42559, Iztlan, W. Mexico, is similar to the preceding but not so black, the dark color inclining to a deep dark sepia, unbroken however, and the rump chestnut, with the feathers dusky centrally. White of upper tail-coverts without dusky shaft-streaks. Wing, 14.60; tail, 10.30; tarsus, 3.25; middle toe, 1.95.] *Immature male* (No. 50763, Tepic, W. Mexico):—Above similar to the adult but less uniform, the nape and back relieved by rusty-fulvous edges to the feathers, the sides of the head and neck more thickly streaked with the same. Lower parts ochraceous, the throat thickly streaked with black; the breast, sides, and abdomen with longitudinally ovate or tear-shaped spots of black, largest on the breast. Tibiæ marked with narrow bars of dusky brown and rusty; crissum paler, relieved only by blackish shaft-streaks. Wings as in the adult, but the rufous more broken, and the remiges more brownish. Tail as in the adult, but the terminal white narrower, less purely white and less sharply defined, the inner webs more or less distinctly barred with white, blackish, and grayish brown. "Iris chestnut-brown; cere, chin, and skin round the eye yellow." *Immature female* (No. 15260, Fort Buchanan, New Mexico):—Similar to the preceding, but black beneath more prevalent, though irregularly broken by whitish edgings and spottings of the feathers; tibiæ more distinctly barred with rusty.

White at the base of the tail more extended and broken, next the dusky portion, with a confused mottling or spotting of grayish and dusky.

There is considerable variation in the plumage of this bird at all ages; but the variations are chiefly in details of coloration, the general style characteristic of the stage being preserved in all cases. In the adult plumage, the chief variation is in the proportionate amount of rufous on the rump, some specimens having the rump as uniformly rufous as the tibiæ or lesser wing-coverts, while in others there is only a strong tinge or spotting of this color; the usual condition is to have the two colors mixed in about equal amount. The only conspicuous variation noticeable in the series under examination is in the markings of the tail-feathers, a single specimen, No. 9134, having the white of the tip extending on some feathers along the edge and thus connected with the basal white. This condition is so entirely exceptional, however, that we are led to believe that it is purely individual, and outside the normal variations which the species ordinarily presents. In the perfect adult plumage of this form, there are no white or ochraceous streaks on the throat or cheeks, nor any white other than that described above, except a faint white sprinkling, seen in some individuals, on the inner webs of the primaries.

We still separate the northern birds of this species from the southern ones, notwithstanding Mr. Sharpe and other prominent authorities unite them, for the reason that we have yet to see a single South American specimen in which the dusky and rufous of the plumage assumes that uniformity characteristic of the adult specimens from Mexico and adjoining provinces. The Chilian specimen described above is the blackest example we have seen of the former, while Temminck's plate, cited above (Pl. Col. 313), represents about the average style. The adult plumage of the South American bird seems, therefore, to correspond with the immature stage of the northern form, or that stage in which the tail is uniform black on the upper surface, with the characteristic basal and terminal white bands, the black, especially that of the lower surface, much broken by whitish edgings and spottings, and the tibiæ merely barred with ferruginous. It is barely possible that we have not seen the most perfect plumage which the adult of the South American bird attains, but Mr. J. H. Gurney, than whom there is not a more competent authority, in commenting on our statement to this effect in History of North American Birds (vol. iii, p. 249), says that so far as he has had an opportunity of examining specimens, our observation is correct. (Cf. Ibis, April, 1875, p. 235.)

List of specimens in United States National Museum.

a. UNICINCTUS.

Catalogue No.	Sex and age.	Locality.	Date.	Donor.
13907	♀ ad.	Chili		Lieutenant Gilliss
13908	♂ ad.	....do		Do.
16572	— juv.	Bogota		W. Evans.
32971	♀ ——	Chili		Verreaux.
32972	♂ juv.	....do		Do.
36667	— juv.	Amazonia		N. H. Mus. Rio.
48813	♂ ——	Chili (Santiago)	June, 1864	Nat. Mus. Chili.
48814	♀ ——	....do	....do	Do.
48815	♀ juv.	....do	July, 1864	Do.
49507	♀ juv.	Conchitas, Buenos Ayres	May, 1867	W. H. Hudson.
54111	♂ juv.	Guayaquil, Ecuador		J. F. Reeves.
54935	— ad.	....do		Dr. Destruge.

Other specimens examined.—In mus. Philad. Acad., 9; Am. Mus., N. Y., 1; Boston Soc. 4; total, 26.

Measurements.

Sex.	Wing.	Tail.	Culmen.	Tarsus.	Middle toe.	No. of specimens.
♂	11.65–13.15	9.00–10.10	0.82–1.00	2.78–3.40	1.52–1.75	8
♀	12.50–14.60	9.20–10.50	0.90–1.02	3.10–3.40	1.60–1.85	6

β HARRISI.

Catalogue No.	Original No.	Sex and age.	Locality.	Date.	Donor.	Remarks.
4123	.....	—	Brownsville, Texas	Sept. —, 1853	Lieut. Couch	
9134	179	♂juv.	New Mexico	Feb. 27, 1854	Lieut. Whipple	Transition pl.
9135	.....	— ad.	Oyster Point, Texas	Sept. —, 1853	Major Emory	
16929	.....	♂	Cape St. Lucas	.....	J. Xantus	
17230	2499	—	do	Jan. 14, 1859	do	
17231	2450	♂juv.	do	Nov. 11, 1859	do	Transition pl.
17232	3218	♀	do	Sept. 8, 1859	do	
17233	3452	♂	San José, Lower California	Dec. 18, 1859	do	
18280	.....	♀juv.	Fort Buchanan, New Mexico	.....	Dr. Irwin	
35059	2277	♂ ad.	Rio de Coahuyana, W. Mexico	Oct. —, ——	J. Xantus	
35120	.....	♂	do	Sept. —, 1863	do	
40951	.....	♀ ad.	Chimandega, Nicaragua	.....	F. Hicks	
40952	.....	—juv.	do	.....	do	Transition pl.
48509	.....	— ad.	Istlan, Western Mexico	.....	Colonel Grayson	
50763	495	♂juv.	Tepic, Western Mexico	.....	do	
51311	.....	♀ ad.	Mazatlan, Western Mexico	Feb. —, 1868	F. Bischoff	
51312	.....	—	do	Feb. —, 1868	do	
51313	.....	♂	do	Mar. —, 1867	do	
51314	.....	♂	do	Jan. —, 1868	do	
51315	.....	♂	do	Jan. —, 1868	do	
51316	.....	♂	do	Dec. —, 1867	do	
52927	497	♀ ad.	do	.....	Colonel Grayson	
59507	925	—	Tehuantepec	Oct. —, 1869	Prof. Sumichrast	
59508	891	—	do	Oct. —, 1869	do	
59509	897	—	do	Oct. —, 1869	do	

Other specimens examined.—In mus. Philad. Acad., 3; G. N. Lawrence, 2; R. Ridgway, 1; total number of specimens examined, 31.

Collector's notes on United States National Museum specimens.

No. 4123: length, 17.50; extent, 37.50; eye dark brown; feet yellow; bill bluish.
No. 9134: length, 19; extent, 37.00; eye dark yellow.
No. 16929: length, 23.40; extent, 49.00.
No. 17230: length, 22.00; extent, 45.50.
No. 17231: length, 24.00; extent, 45.00.
No. 17232: length, 21.00; extent, 44.00.
No. 17233: length, 21.40; extent, 40.00.
No. 35120: length, 23.00.
No. 51311: eye brown.

Measurements.

Sex.	Wing.	Tail.	Culmen.	Tarsus.	Middle toe.	No. of specimens.
♂	12.35–13.75	9.80–10.20	0.90–0.95	3.15–3.20	1.65–1.70	8
♀	14.25–14.50	10.80–11.00	1.08–1.10	3.40–3.75	1.90–2.00	6

GENUS SPIZIASTUR, LESSON.

"*Spizastur* LESS.", GRAY, List Gen. Subgen. 1843, 3. Type, *Falco atricapillus* TEMM. *S. melanoleucus* (VIEILL). *Spiziastur* KAUP, 1851.—SHARPE, Cat. Acc. Brit. Mus. 1874, 258.

CH.—Similar to *Spizaëtus*, but primaries longer, bill more compressed, toes and claws much longer, and head without an occipital crest. Bill much compressed, the tomia without distinct sinuations; anterior outline of the cere simply convex. Nostril oval, vertical, near the middle of the cere. Tarsus about one and a half times the length of the middle toe; lateral toes nearly equal, but the outer perceptibly the longer, reaching to about the middle of the subterminal phalanx of the middle toe; posterior toe longer than the outer. Claws excessively graduated, the first and second being extremely long, exceeding their digits, the outer small, less than two-thirds its digit, the third being intermediate in length; their form normal. A distinct web between outer and middle toes. Tarsi densely feathered all round, only the lower joint exposed. Lores densely clothed with short, stiff bristles. Primaries exceeding the secondaries by about one-fourth the length of the wing; third, fourth, fifth, and sixth quills nearly equal, and longest, but the fourth and fifth usually exceeding the others; first shortest; inner webs of the outer five distinctly emarginated, the sixth faintly sinuated; secondaries, 14. Tail long, about two-thirds the wing, even, or very slightly rounded; composed of 12 feathers, the basal half overlaid by the coverts.

SPIZIASTUR MELANOLEUCUS.

Buteo melanoleucus VIEILL. N. D. iv, 1816, 482.—CUVIER, Règ. An. 1817, 336.—VIEILL. & OUD. Gal. Ois. 1825, pl. 14.
Spizaëtus melanoleucus BONAP. Consp. i, 1850, 28; Rev. Zool. 1850, 448.—STRICKL. Orn. Syn. i, 1855, 73.—SCHL. Mus. P.-B. Astures, 1862, 14.—LAWR. Ann. Lyc. N. Y. ix, 1868, 132 (Costa Rica).—GRAY, Hand List, i, 1869, 12.—SCL. & SALV. P. Z. S. 1864, 369 (Isth. Panama); Nom. Neotr. 1873, 120.
Spizaëtus (*Spizastur*) *melanoleucus* RIDGW. Pr. Boston Soc. N. H. 1873, 71.
Spizastur melanoleucus SHARPE, Cat. Acc. B. M. 1874, 258.
Falco atricapillus TEMM. Pl. Col. i, 1823, pl. 79.
Morphnus? atricapillus VIG. Zoöl. Journ. i, 1824, 325.—STEPHENS, Zoölogy, xiii, 20.
Astur atricapillus LESS. Man. i, 1828, 93.
Spizastur atricapillus GRAY, List Gen. 1841, 3.—KAUP, Mus. Senck. iii, 1845, 259.
Spizaëtus atricapillus GRAY, Gen. 1845, 14.—BONAP. Consp. Av. i, 1850, 28.—BURM. Th. Bras. 1856, 65.—PELZ. Orn. Bras. 1871, 4.
"*Spizastur atriceps* KAUP, Mus. Senck. iii, 1845, 259" (*fide* STRICKLAND, *l. c.*).

Hab.—Central Tropical America, south to Brazil, north to Guatemala. Guiana (MUS. BOSTON SOC.); Costa Rica (NAT. MUS.).

Wing, 14.30–16.40; tail, 9.50–11.00; culmen, 0.95–1.20; tarsus, 2.65–3.25; middle toe, 1.95–2.25. *Adult:*—Upper parts uniform deep black; tail deep black, crossed by four broad bands of brownish-gray, and narrowly tipped with paler. Head, neck, and entire lower parts pure white; lores and eyelids deep black, and occiput spotted with the same. Tibiæ sometimes sparsely barred with black. Cere and rictus deep orange-red in life; bill black.

List of specimens examined.—In Nat. Mus., 1 (No. 51302, La Palma, Costa Rica, Aug. 10, 1867; José C. Zeledon); mus. Philad. Acad., 3; Boston Soc. N. H., 2; G. N. Lawrence, 1; total, 7.

GENUS URUBITINGA, LESSON.

Urubitinga LESSON, Rev. Zool. 1839, 132. No type!—LAFRESNAYE, D'Orb. Dict. d'Hist. Nat. ii, 1842, 786. Type, *Falco urubitinga* GMEL.
Hypomorphnus CABANIS, Weigm. Archiv, 1844, 263. Type, *H. gundlachi* CABAN.
Hypomorphinus GRAY, 1845. Same type.

CH.—Outstretched feet reaching to or beyond the end of the tail; tarsus more than twice the middle toe, which is not conspicuously longer than the lateral toes, the scutellation buteonine. Secondaries greatly developed, reaching nearly or quite to the end of the longest primaries. Remiges 24–25; rectrices 12. Superior tomium of the bill with a distinct lobe; anterior outline of the cere doubly curved, convex above, concave or straight and oblique below. Nostril very broadly oval, or nearly circular (if the former, of horizontal direction), showing, normally, a distinct cartilaginous tubercle. Outer toe more than three-fourths as long as the middle one, and decidedly, though not conspicuously, longer than the inner; posterior toe decidedly shorter than the inner. Claws normal in shape and graduation, the longest one (first) not longer than its digit. Tarsal scutellæ arranged in continuous single series of large transverse plates on the front and posterior faces, and those of the toes uninterrupted nearly or quite to the base. Plumage generally full, the remiges well developed, especially the secondaries, which extend nearly or quite to the ends of the primaries. Under surface of the wing very concave; inner webs of the primaries very shallowly sinuated, the number on which the cutting is apparent rather indefinite, but apparently varying from six to seven. Third, fourth, fifth, and sixth quills longest, the fourth or fifth usually exceeding the others. Tail moderate, more than half the wing, even, or very slightly rounded.

The characters of this genus are quite difficult to define, but consist chiefly in those enumerated above. The genus is most closely related to *Leucopternis*, which, however, we consider distinct, at least subgenerically, on account of important differences to be noticed under the head of that genus. The pterylosis of *Urubitinga* presents many points of resemblance to that of the *Morphni* (*Thrasaëtus* and *Morphnus*), and it is likely that the genus is in other respects intermediate between the latter group and the true *Buteones;* the resemblance is especially great in the wings, the secondaries having a similar excessive development, while the shallow sinuation of an indefinite number of primaries is another point of agreement. According to Nitzsch, the pterylosis is peculiar on account of the narrowness of all the tracts; the jugular portion of the inferior tract with a very narrow inner branch, and united to the pectoral stem by a single row of feathers, the outer branch quite free, but narrow, with a hook of a single row of feathers at its extremity; the main stem somewhat dilated at its extremity. The lumbar tract is perceptible.

Besides the *Falco urubitinga* of Gmelin and the *Falco anthracinus* of Lichtenstein, the *Asturina schistacea* of Sundevall may be regarded as a typical member of this genus. There are also two other species which probably belong here, viz, *Hypomorphnus gundlachi* Cabanis and *Leucopternis plumbea* Salvin; but, as we have seen neither of these species, we include them here provisionally only. The former of these is almost certainly a true *Urubitinga*, since it is so nearly related to *U. anthracina* that Mr. Sharpe considers them identical specifically.

URUBITINGA ZONURA.

Aquila brasiliensis BRISS. Orn. i, 1760, 445.
Urubitinga brasiliensis BONAP. Consp. 29.—PELZ. Orn. Bras. 1871, 2, 393.
Morphnus brasiliensis STRICKL. Orn. Syn. i, 1855, 24.
Falco urubitinga GMEL. S. N. 1788, 265.—LATH. Ind. Orn. 22; Gen. Hist. i, 236.—DAUD. Tr. Orn. ii, 57.—SHAW, Zoöl. vii, 63.—TEMM. Pl. Col. i, 1825, pl. 55.
Aquila urubitinga SPIX, Av. Bras. i, 1824, pl. 1[b].
Morphnus urubitinga CUV. Règ. An. ed. 2, i, 1829, 330.—VIG. Z. J. i, 323, 327.—STEPH. Zoöl. xiii, pt. 2, 17.—LESS. Man. i, 90; Tr. 51.—NITZSCH, Pterylog. 87.—GRAY, Gen. 2; ed. 2, i, 1845, 3; fol. sp. 1, pl 7, f. 6; List B. Brit. Mus. 21.—D'ORB. Voy. Am. Mér. Ois. 1847, 84.—SCL. P. Z. S. 1857, 226 (S. Mexico).
Hypomorphnus urubitinga CABAN. & TSCH. Consp. Av. Weigm. Ar. 1844, 263; Fauna Per. 1844, 16, 84.—LAFR. R. Z. 1849, 99.—R. SCHOM. Brit. Guian. 1848, 740.—BURM. Thiere Bras. ii, 1856, 42; P. Z. S. 1868, 633 (Mendoza, Buenos Ayres).
Harpyia urubitinga SWAINS. Class. ii, 1837, 208.
Asturina urubitinga SCHLEG. Mus. P.-B. Asturinæ, 1862, 6; Revue, 1873, 103.
Aquila picata SPIX, Av. Bras. i, 1824, pl. 1*b* (juv.).
Falco zonurus SHAW, Zoöl. vii, 1809, 62.
Urubitinga zonura SCL. Trans, Zoöl. Soc. 1858, 262.—SHARPE, Cat. Acc. Brit. Mus. 1874, 213.—LAWR. Ann. Lyc. N. Y. vii, 1861, p. — (New Granada); Mem. Bost. Soc. N. H. ii, 1874, 302 (Mazatlan; biog. notes).—RIDGW. Pr. Boston Soc. N. H. 1873, 62.
Falco longipes ILLIG. in Mus. Berl. *undè*—
Urubitinga longipes BON. Consp. i, 1850, 29.
Pandion fulvus VIEILL. N. D. iii, 1816, 163.
Spizaëtus niger VIEILL. N. D. xxxii, 1819, 57.
Spizaëtus ater VIEILL. *ib.* 58.
Urubitinga MARCGR. Hist. Bras. 1648, 214.
L'Aigle du Brésil BRISS. Orn. i, 1760, 445.
Del Chorreado, Del Pintado, and *Del Negro* AZARA, Pax. Par. i, 1802, 88, 92, 96.
Aigle noir huppé d'Amérique BUFF. Ois. ed. Sonn. ii, 29, pl. 6.
Brazilian Eagle LATH. Synop. i, 1781, 41, sp. 20.

Hab.—Tropical America, south to Paraguay and the Argentine Republic, north to Vera Cruz and Mazatlan.

Wing, 15.00–18.00; tail, 10.50–12.00; culmen, 1.10–1.35; tarsus, 2.45–4.80; middle toe, 1.70–2.10. Bill elongated and compressed, the tip well produced; upper outline of the cere nearly parallel with the lower. Primaries decidedly longer than the secondaries, the inner webs of the outer five or six slightly sinuated; fourth or fifth quill longest; first shorter than the ninth. Tail nearly even, but the lateral pair slightly shortest. *Upper tail-coverts white. Adult:*—Uniform black, with more or less of a plumbeous cast, especially on the neck, jugulum, and back; remiges indistinctly banded with dark plumbeous. Upper tail-coverts, end of tail, and one or two wide bands across the tail, pure white; tibiæ and lining of the wing sometimes barred with white. "Iris brown; cere, lores, and feet yellow." *Young:*—Above blackish-brown or brownish-black, variegated with broad ochraceous edgings to some of the scapulars. Wings dusky brown, all the larger coverts and the remiges indistinctly banded with black. Head, neck, and lower parts light ochraceous, each feather with a sharply-defined medial streak of black; these streaks lanceolate on the head and neck, more cuneate on the jugulum, and on the abdomen and side sometimes suffused into a prevalent irregular spotting. Tibiæ transversely barred with black and light ochraceous. On the head, the dark streaks are very minute, or nearly absent, in a conspicuous, broad, superciliary stripe, and on the cheeks and throat; while they blend from the posterior angle of the eye back along the upper edge of the auriculars, thence down the side of the neck, and across the jugulum, forming an interrupted collar of cuneate streaks. Under surface of the remiges trans-

versely banded with ochraceous. (I.) Tail black, tipped with whitish, and crossed by eight to ten narrow bands of clouded ashy and ochraceous, the former prevailing on the outer, and the latter on the inner webs (II.) Prevailing color of the tail white, with a grayish-brown, mostly longitudinal, mottling, crossed near the end by a broad zone of black about 2.00–2.50 wide, the tip again white. The whitish portion crossed by five or six irregular, narrow, zigzag bands of black, these often so irregular as to hardly appear as bands when the tail is closed. *Hab.*—South and Middle America, from Buenos Ayres and Paraguay to Mazatlan and Vera Cruz.

The South American and Middle American specimens of this species are so easily distinguished that they seem to be separable as well-marked geographical races, characterized as follows:—

a. Tail white, with a basal narrow band and wide subterminal zone of black. Tibiæ and lining of wing without white bars. Wing, 16.50–18.00; tail, 11.75–12.00; culmen, 1.30; tarsus, 4.90–5.00; middle toe, 1.90–2.10. *Hab.*—Eastern South America, south to Buenos Ayres and Paraguay ..... *a. zonura.*

β. Tail black, with a medial zone and terminal and basal narrow bands of white. Tibiæ and lining of the wing with conspicuous white bars. Wing, 15.15–16.50; tail, 10.50–11.50; culmen, 1.10–1.35; tarsus, 4.30–4.85; middle toe, 1.60–1.90 *Hab.*—Middle America, north to Vera Cruz, Tehuantepec, and Mazatlan..... *β.* ——?

In the northern form, the black appears to be constantly of a more plumbeous cast, the neck, back, and jugulum decidedly glaucous; the bill is also not so deep, its length being about the same; the plumbeous bands on the remiges are also more distinct. The subterminal black zone of the tail is from 3 to 4 inches in width, the white one just anterior to it 1.50 to 1.80; the next black one about the same width; and the basal or sub-basal white one a little wider than the terminal band of about half an inch in width. In the southern form, the terminal white and subterminal black are about the same widths as in the northern style, but the white zone across the middle is 4.00 to 4.50, instead of only 1.50 to 1.80 in breadth, while the black just preceding it is narrow and either basal or merely mottled with whitish at the roots.

There are no young specimens of the southern race in the National collection.

List of specimens in United States National Museum.

Catalogue No.	Original No.	Sex and age.	Locality.	Date.	Donor.
20931	41	.....	Vermejo River, Arg. Rep.	.....	Capt. T. J. Page, U. S. N.
29304	.....	♂ —	Colima, Western Mexico	Feb. —, 1864	J. Xantus.
30239	.....	♂ juv.	Mirador, Eastern Mexico	Nov. —, 1864	Dr. C. Sartorius.
30900	.....	.....	Rio Tupila, Western Mexico....	Apr. —, ——	J. Xantus.
32969	.....	.....	Guatemala	.....	Verreaux.
33104	24	♂ —	Costa Rica (San José)	Jan. 28, 1864	J. Carmiol.
34062	.....	.....	Realejo, Central America.....	Feb. —, ——	Capt. J. M. Dow.
37870	153	♂ —	Yucatan (Merida).....	Feb. 8, 1865	Dr. A. Schott.
42137	.....	.....	Tehuantepec (Protrero)	Feb. —, 1866	Prof. F. Sumichrast.
50767	759	.....	Mazatlan Western Mexico	.....	Col. A. J. Grayson.
52764	.....	.....	..... do	.....	Do.
59002	10	— ad.	Paraguay	.....	Capt. Page.
68428	20	— juv.	Costa Rica (Lipurio)	—— —, 1873	Prof. W. M. Gabb.
67282	11c	.....	Tehuantepec	Sept. —, 1872	Prof. F. Sumichrast.
57859	552	— juv.	..... do	Feb. 2, 1869	Do.
58510	923	♂ ad.	..... do	Oct. —, 1869	Do.

Other specimens examined.—In mus. Philad. Acad., 9; Boston Soc., 4; Am. Mus., N.Y., 1; G. N. Lawrence, 3; total, 32.

Measurements.

Sex.	Wing.	Tail.	Culmen.	Tarsus.	Middle toe.	No. of specimens.
♂	15.00–16.30	10.50–11.00	1.25	4.40–4.60	1.90–1.95	6
♀	16.00–17.50	11.10–12.00	1.20	4.60–4.70	1.85–2.10	4

URUBITINGA ANTHRACINA.

"*Falco anthracinus* LICHT.", NITZSCH, Pterylography, 1840, 83.—LAFR. Rev. Zool, 1848, 240

Morphnus anthracinus STRICKL. Orn. Syn. i, 1855, 25.—SCL. P. Z. S. 1857, 210 (Orizaba).

Urubitinga anthracina LAFR. Rev. Zool. 1848, 241.—SCL. Trans. Zoöl. Soc. 1858, 262: P. Z. S. 1858, 294 (Oaxaca); *ib.* 1868, 629 (Venezuela); *ib.* 1870, 838 (coast of Honduras).—SCL. & SALV. Ibis, 1859, 216; P. Z. S. 1864, 369 (Panama); Nom. Neotr. 1873, 119.—LAWRENCE, Ann. Lyc. N. Y. vii, 1861, p. — (New Granada); *ib.* viii, 1865, 185 (Nicaragua); *ib.* ix, 1868, 133 (Costa Rica); Mem. Boston Soc. N. H. ii, 1874, 302 (Mazatlan; biog. notes).—SALVIN, P. Z. S. 1870, 215, (Veragua); *ib.* 838 (Honduras).—PELZ. Orn. Bras. 1871, 394.—RIDGW. Pr. Boston Soc. N. H. 1873, 63.—SHARPE, Cat. Acc. Brit. Mus. 1874, 215.

Asturina anthracina SCHLEG. Mus. Pays-Bas. Asturinæ, 1862, 8.

Buteo anthracinus GRAY, Hand List, i, 1869, 9.

Morphnus mexicanus DU BUS. Bull. Ac. Brux. xiv, 1847, pt. 2, 102.—GRAY, Gen. App. 1.—LAFR. Rev. Zool. 1848, 239.

Urubitinga mexicana BONAP. Rev. Zool. 1850, 488.—CASSIN, Pr. Ac. Nat. Sc. Philad. xii, 1860, p. — (Panama).

Hab.—Tropical America, from Brazil, Guiana, and New Granada northward as far as the southern border of the western United States. Arizona (breeding) BENDIRE and HENSHAW.

Wing, 13.15–15.80; tail, 7.90–11.00; culmen, 1.00–1.10; tarsus, 3.00–3.50; middle toe, 1.60–1.80. Third and fifth quills longest, the first intermediate between the eighth and tenth; outer four with the inner webs slightly sinuated. Tail very slightly rounded, the outer pair of feathers just appreciably the shortest. *Upper tail-coverts black, barred with white. Adult:*—General color uniform black, with a strong glaucous cast on the back, neck, and breast; upper tail-coverts narrowly tipped with white; tail deep black, narrowly tipped with white, white at the extreme base and crossed at about the middle by a broad, continuous zone of the same, of variable width. Inner webs and the concealed portion of the outer webs of the secondaries usually (but not always) mottled with rusty ochraceous; terminal half of the bill plumbeous-black; the basal half, the cere, and the rictus yellow; tarsi and toes yellow; claws plumbeous-black. *Young:*—Above brownish-black, more or less variegated with ochraceous and sometimes with rusty on wing-coverts and scapulars; wings indistinctly banded with dark grayish-brown; head, neck, and lower parts ochraceous-white, with longitudinal stripes of black; tibiæ transversely barred with the same; tail crossed with about seven bands of black and white, the bands of each individual feather oblique; the relative width of the two colors varying with the individual, but the subterminal black band always about twice as broad as the others. Inner webs of secondaries strongly tinged with rufous. Upper tail-coverts white, more or less barred with black. On the head and neck, the streaking is not uniform, but the areas where the light or dark markings predominate respectively are as follows: the gular region, cheeks, and supraoral region are whitish, with fine streaks; but the pileum and nape, upper half of the auriculars, and maxillary stripe extending across the jugulum are nearly uniformly black, in consequence of the enlargement and blending of the streaks. "Iris brown; cere and base of bill olive-yellow or greenish; feet yellow."

The white tail-bands vary considerably in width with the specimen; but we cannot discover any rule of difference according to locality or

sex. The extremes are represented by No. 57845, Tehuantepec, Mexico, and No. 40394, Nicaragua. In the former, the middle band is less than an inch wide, while the terminal one is so abraded that only traces of it are discernible on some feathers; on the inner webs, there are three indistinct narrower bands anterior to the main one, but of these there is no trace on the outer webs. In the other specimen, the main tail-band is over two inches wide on the intermediæ, gradually narrowing to about one inch on the lateral pair; anterior to this, there are two or three narrow, badly-defined, white bands on the inner webs, as in the Nicaragua specimen; the terminal band is about half an inch wide.

As in *U. zonura*, there is much difference in the amount of glaucous or chalky cast to the plumage in different individuals, but it is nearly always very conspicuous in certain lights. There is also much variation in the amount of the rusty spotting on the secondaries, this sometimes showing conspicuously on the outer webs, even in the closed wing (as in Nos. 17785 and 54030), while again (as in most Central American and Mexican specimens) it is almost wanting even on the inner webs.

Many adult specimens have white filamentous attachments to the tips of the shafts of the tibial plumes, and feathers of the chin, throat, and cheeks, like those observable in the type of *Onychotes gruberi*.

There are no specimens from south of Panama now before us for comparison with northern ones, but examples from the Isthmus are similar to those from Mexico.

List of specimens in United States National Museum.

Catalogue No.	Original No.	Sex and age.	Locality.	Date.	Donor.
17785	285	♂ ad.	Rio Atrato, New Granada	.....	Dr. A. Schott.
22405	156	.....	Punta Arenas, Costa Rica	July 3, 1858	O. Salvin.
27101	41	.....	Mirador, Eastern Mexico	.....	Dr. C. Sartorius.
29403	138	♂ ad.	Colima, Western Mexico	Feb. —, 1863	J. Xantus.
29038	.....	♂juv.	Mazatlan, Western Mexico	.....	Col. A. J. Grayson.
30411	.....	— ad.	Costa Rica	.....	Dr. A. von Frantzius.
30539	.....	♂ ad.	Orizaba, Eastern Mexico	Mar. 14, 1863	Prof. F. Sumichrast.
30540	.....	—juv.	Acajutla, Central America	Mar. 11, 1863	Capt. J. M. Dow.
32970	.....	♀juv.	Mexico	.....	Verreaux.
33903	159	.....	Costa Rica (San José)	.....	Dr. von Frantzius.
35058	2010	♀juv.	Rio de Coahuyana, Western Mexico	Sept. —, ——	J. Xantus.
40394	.....	— ad.	Nicaragua	.....	Holland.
41247	.....	♂ —	Costa Rica (Angostura)	Mar. 30, 1865	J. Carmiol.
41781	.....	♂ —	Orizaba	Nov. —, ——	Professor Sumichrast.
49072	202	♀ —	Mirador	.....	Dr. Sartorius.
50768	.....	.....	Mazatlan	.....	Colonel Grayson.
50769	763	.....	San Blas, Western Mexico	.....	Do.
52923	855	—juv.	Mazatlan	.....	Do.
54030	.....	♂ ad.	Panama	—— —, 1862	McLeannan.
54110	.....	—juv.	Puna Island, Guayaquil, Ecuador	.....	J. F. Reeve.
57845	563	— ad.	Tehuantepec, Southern Mexico	Feb. 1, 1869	Prof. F. Sumichrast.
57861	515	♀ —	.....do	Jan. 25, 1869	Do.
57862	349	♂ —	.....do	Dec. 30, 1868	Do.
58777	764	.....	Mazatlan	.....	Colonel Grayson.
58859	702	♀ ad.	Tehuantepec	May 30, 1869	Professor Sumichrast.
59023	.....	♀ —	Acajutla Central America	Aug. —, 1863	Captain Dow.
64050	563	— ad.	Costa Rica, (Talamanca)	—— —, 1873	Prof. W. M. Gabb.
64051	199	— ad.	.....do	—— —, 1873	Do.
66869	2	♂juv.	Costa Rica (Old Harbor)	July 14, 1874	Do.
67863	1*	♂ ad.	Tehuantepec	April 3, 1872	Professor Sumichrast.
67879	.....	— ad.	Costa Rica (Talamanca)	.....	Professor Gabb.
67880	.....	♂ ad.	.....do	.....	Do.
67881	.....	♂ ad.	.....do	.....	Do.
67882	.....	♀juv.	.....do	.....	Do.
67883	.....	♀juv.	.....do	.....	Do.

Other specimens examined.—In mus. Philad. Acad., 4; Boston Soc., 5; Am. Mus., N. Y., 1; G. N. Lawrence, 3; total, 48.

Measurements.

Sex.	Wing.	Tail.	Culmen.	Tarsus.	Middle toe.	No. of specimens.
♂	13.15–14.90	7.90– 9.75	1.00–1.05	3.20–3.40	1.62–1.70	8
♀	14.25–14.60	9.25–11.00	1.05–1.10	3.00–3.50	1.65–1.80	12

URUBITINGA SCHISTACEA.

Asturina schistacea SUND. Œfv. Af. Vet. Förh. 1849, 132.—SCHLEG. Mus. Pays-Bas, Asturinæ, 1862, 8.
Morphnus schistaceus SCL. P. Z. S. 1857, 226 (S. Mexico); *ib.* 261 (Upper Amazon).
Urubitinga schistacea SCL. P. Z. S. 1858, 128; Trans. Z. S. 1858, 261, pl. 58.—SCL. & SALV. P. Z. S. 1866, 198; 1867, 979.—PELZ. Orn. Bras. 1871, 2, 394.—SALV. Ibis 1872, 243.—SHARPE, Cat. B. Brit. Mus. 1874, 216.
Buteo schistaceus GRAY, Hand List, i, 1869, 9.
Leucopternis schistacea SALV. Ibis, 1872, 243.—SCL. & SALV. Nom. Neot. 1873, 119.
Falco ardesiaceus LICHT. in Mus. Berol. *teste* BONAP.
Hyphomorphnus ardesiaceus LICHT. Nomencl. 1854, 1.

Hab.—Northern and Eastern South America. S. Mexico (SCLATER, l. c.) Ecuador and Bogota (SALVIN); Brazil (Rio Madeira et Rio Negro, NATTERER); Bolivia (SCLATER); Peru (U. S. NAT. MUS.); Para et Cayenne (SCHLEGEL).

Wing, 9.40–11.90; tail, 5.80–7.80; culmen, 0.90–0.95; tarsus, 2.50–3.20; middle toe, 1.35–1.50. Bill comparatively short and broad, the upper outline of the cere decidedly ascending basally, and distinctly arched. Nostril nearly circular. Remiges 24; fourth or fifth quill longest, first shortest; outer five with inner webs faintly sinuated. *Adult:*—Uniform slaty plumbeous, darker on the head and primaries. Tail deep black (the extreme base dusky), with a narrow white tip, and crossed about the middle by a narrow continuous band of white, about 0.50 to 0.75 of an inch wide. Tibiæ sometimes barred, more or less distinctly, with white, and lining of the wing more irregularly variegated with the same.

Specimens examined.—In U. S. Nat. Mus., 1 (No. 55281, ♂, adult, Pebas, Peru, J. Hauxwell *); Mus. Comp. Zoöl., Cambridge, 1; total, 2.

APPENDIX.

(*Pertaining to species probably referrible to this genus, not examined by us.*)

1. URUBITINGA (?) PLUMBEA.

Leucopternis plumbea SALVIN, Ibis, 1872, 240, pl. viii.—SCL. & SALV. Nom. Neotr. 1873, 119.
Urubitinga plumbea SHARPE, Cat. Acc. Brit. Mus. 1874, 216.

"*Adult* (type of species).—Everywhere leaden-gray; wing-coverts and quills black, the latter with a single bar of white, somewhat shaded with ashy across the middle; tibial plumes indistinctly barred with white; under wing-coverts white; cere, orbits, and feet orange; bill and claws black. Total length 14.5 inches, culmen 1.5, wing 9.8, tail 6.7, tarsus 2.5. (*Mus. Salvin and Godman.*) *Hab.*—Ecuador and Panama."—(SHARPE, *l. c.*)

This species is apparently closely related to *U. schistacea*, from which, however, it differs in smaller size and white under wing-coverts.

* "Iris yellow."

2. URUBITINGA "GUNDLACHI".

'*Morphnus urubitinga* CUVIER", LEMBEYE, Aves de Cuba, 1850, 14, pl. iii, fig. 3.—MARCH, Pr. Ac. Nat. Sci. Philad. 1863, 3 (Jamaica).
Hypomorphnus gundlachi CABANIS, Journ. für Orn. 1854, pl. lxxx.—BREWER, Pr. Boston Soc. N. H. vii, 1860, p. — (Cuba).—? FINSCH, P. Z. S. 1870, 554 (Trinidad).—GUNDL. Journ. für Orn. 1871, 365.
?"*Astur unicinctus*" LÉOT. Ois. Trinidad, 1866, 44.
Urubitinga anthracina (part) SHARPE, Cat. Acc. Brit. Mus. 1874, 215.

Hab.—Cuba. (Also Jamaica and Trinidad ?).

This bird has been referred by Mr. Sharpe to *U. anthracina*, but we think without sufficient reason for so doing. It seems to be really a good species, but quite nearly related to the continental one. According to Dr. Finsch (*l. c.*) "the whole plumage is dark brownish-black; the feathers on the upper part of the interscapulium are rufous at the base; the upper and under tail-coverts are margined narrowly with white; the tail has a broad white cross-band, above this is another much narrower and not quite complete, a third, still narrower, and ill-defined, is placed at the base and hidden by the tail-coverts; the tail-feathers are tipped with white; the under surface of the wings shows a white space formed by the white basal third of the first four primaries, but this white is speckled very minutely with grayish-black, as in *H. anthracinus;* the secondaries bear in the middle portion of the inner web six or seven cross-bands of pale rufous-brown, somewhat ill-defined, and mixed and washed with dark brown, giving a somewhat marmorated appearance." He adds that it is "closely related to *H. anthracinus* Licht., *but may be easily distinguished* by the two white bands on the base of the tail, besides the white middle cross-band."

The difference in the markings of the tail are quite sufficient to separate this bird from *U. anthracina*, at least as a geographical race, since of the very numerous individuals we have examined not one had any white bands across the tail anterior to the middle zone, other than faint indications, usually on the inner webs, in a very few exceptional cases. It seems, however, to be scarcely distinct specifically, but the descriptions are hardly concise enough to settle the question.

GENUS LEUCOPTERNIS, KAUP.

Dædalion VIGORS, 1824 (not of Savigny, 1809). [*Fide* G. R. Gray.]
Leucopternis KAUP, Isis, 1847, 210. Type, *Falco melanops* TEMMINCK.
Pseudastur BLYTH, Cat. Birds Mus. Asiat. Soc. Bengal, 1849, 24. Type, *Falco lacernulatus* TEMM.

CH.—Similar to *Urubitinga*, but tarsus not more than twice as long as the middle toe; inner webs of only four or five outer primaries cut (the cutting being a distinct emargination); and nostril more nearly circular, and rather vertical than horizontal.

This genus is most similar to *Urubitinga*, but presents the above well-marked differences, with the addition of another and equally important one, viz, the similarity of the young and adult stages in plumage. The colors, too, are chiefly or largely white, instead of mainly black. There is also a very close relationship to *Asturina*, but in the latter the old and young stages of plumage are exceedingly dissimilar, the nostril is very decidedly horizontal, and the emarginations of the primaries end abruptly with the fourth, on which it is very distinct. The genus *Rupornis*, next in order of relationship, is still more remotely allied.

The sternum of *L. semiplumbeus* most resembles that of *Asturina plagiata* (it has not been compared with that of *A. nitida*), from which it differs mainly in smaller size. That of *Rupornis* (*ruficauda*) differs conspicuously in much greater posterior breadth and larger foramina, which in the other two are sometimes nearly or quite obsolete, and always small.

LEUCOPTERNIS GHIESBRECHTI.

Buteo ghiesbrechti DUBUS, Esq. Orn. 1843, pl. 1.—GRAY, Gen. fol. sp. 18.—STRICKL. Orn. Syn. i, 1855, 36.—SCL. P. Z. S. 1857, 227 (Southern Mexico).—SCL. & SALV. Ibis, 1859, 217.—LAWR. Ann. N. Y. Lyc. vii, 1861, 289.—SALV. P. Z. S. 1867, 158 (Veragua).—GRAY, Hand List, i, 1869, 8.—SUMICHRAST, Mem. Bost. Soc. N. H. i, 1869, 560 (Vera Cruz, hot reg.).
Leucopternis ghiesbreghti BONAP. R. Z. 1850, 481; Consp. 19.—SCL. & SALV. Ex. Orn. 1868, 121; Nom. Neot. 1873, 119.—SALV. P. Z. S. 1870, 250; Ibis, 1872, 242.
Tachytriorchis ghiesbrechti BON. C. R. xli, 1855, 651.
Asturina ghiesbrechti SCHL. Mus. P.-B. *Asturinæ*, 1862, 11.
Urubitinga ghiesbrechti SHARPE, Cat. Acc. B. M. 1874, 217.

Hab.—Middle America, from Panama to Mirador.

Wing, 12.00–15.25; tail, 8.50–9.50; culmen, 1.05; tarsus, 2.80–3.65; middle-toe, 1.50–1.70. Fourth or fifth quills longest; first shorter than seventh, sometimes shortest. Almost entirely pure white; a broad zone across the tail near its end, and a portion of the primaries, primary-coverts, and alulæ deep black. *Adult:*—Basal half or more of the primaries white; no bars on the wing. *Young:*—Primaries black nearly to the base, or else the white portion barred with black: wing-coverts more or less barred with black on the lower feathers. Loral bristles and streak behind the eye black. In the youngest specimens, the black portion of the primaries barred with paler.

List of specimens in United States National Museum.

Catalogue No.	Original No.	Sex and age.	Locality.	When collected.	From whom received.
33602	2231	.....	Guatemala	— —, 1860	O. Salvin.
42128	198	♂ ad.	Mirador, Mexico	.....	Dr. Sartorius.
50872	.....	— ad.	.....do	.....	Do.
54023	198	♀	Panama	.....	McLeannan.
54023	.....	♂	.....do	.....	Do.

Other specimens examined.—In mus. Philad. Acad., 2; Am. Mus., N. Y., 1; G. N. Lawrence, 2; total, 10.

Measurements.

Sex.	Wing.	Tail.	Culmen.	Tarsus.	Middle toe.	No. of specimens.
♂	12.00	9.25	1.05	2.85	1.55	1
♀	14.25–14.85	9.25–9.50	1.05	3.30–3.40	1.60–1.65	2

LEUCOPTERNIS PALLIATUS.

Buteo polionotus GRAY, List Accip. 1844, 17; (no description!); Hand List, i, 1869, 8.—KAUP, Isis, 1847, 212.—STRICKL. Orn. Syn. i, 1855, 37.
Leucopternis polionota, KAUP, Isis, 1847, 212.—BONAP. Consp. i, 19.
Falco palliatus NATT. MS. unde ——
Leucopternis palliata PELZ. Sitz. Ak, Wien, xliv, 1861, 11; Verh. Zool.-Bot. Ges. Wien, 1862, 141, 184; Ueb. Falk. 1862, 7 (Brazil); Orn. Bras. 1871, 3.—SCL. & SALV. Ex. Orn. vii, 1868, pl. xlix; Nom. Av. Neotrop. 1873, 119.—SALV. Ibis, 1872, 242.
Urubitinga palliata SHARPE Cat. Acc. B. M. 1874, 218.
Asturina melanonota SCHL. Mus. P.-B. Asturinæ 1862, 10, (not of VIEILL.!); Rev. 1873, 103.

Hab.—Southeastern Brazil (SCL. and SALV.); Maceo, Amazonia (MUS. COMP. ZOÖL., No. 7219).

Wing, 14.25–16.50; tail, 8.00–9.00; culmen, 1.05; bill from tip to rictus, 1.60–1.80; tarsus, 3.50–3.80. *Adult:*—Head, neck, entire lower parts, and terminal one-third to one-half the tail continuous pure white; upper parts (except head and neck), including basal half or two-thirds of the tail, dark plumbeous or plumbeous-black; scapulars, secondaries, and inner primaries tipped with white; dorsal feathers transversely variegated with white beneath the surface; inner webs of primaries and rectrices pale ashy or white, transversely barred with darker.

"Cere pale yellow; feet pale orange-yellow; claws black; iris not very dark brown."—(NATTERER, *fide* SHARPE, *l. c.*)

LEUCOPTERNIS LACERNULATA

Falco lacernulatus TEMM. Pl. Col. i, 1827, 437.
Buteo lacernulatus CUV. Règ. An. ed. 2, i, 1829, 337.—LESS. Tr. Orn. 82.—GRAY, Gen. fol. sp. 16; List B. Brit. Mus. 17.—STRICKL. Orn. Syn. i, 1855, 34.
Leucopternis lacernulata BONAP. Consp. i, 1850, 19.
Urubitinga lacernulata SHARPE, Cat. Acc. B. M. 1874, 218.
Falco skotopterus MAX. Beitr. iii, 1830, 204.
Buteo scotopterus BURM. Syst. Ueb. ii, 51; Thiere Bras. ii, 1856, 51.—GRAY, List B. Brit. Mus. 1848, 38; Hand List, i, 1869, 8.—STRICKL. Orn. Syn. i, 1855, 34.

Leucopternis scotopterus KAUP, Contr. Orn. 1850, 69.—PELZ. Verh. Zoöl.-Bot. Ges. Wien, 1862, 19; Orn. Bras. 3.—SCL. & SALV. Ex. Orn. 1868 (syn. and ch. under text of *L. semiplumbeus*); Nom. Av. Neotrop. 119.—SALV. Ibis, 1872, 242.—GRAY, Hand List, i, 1869, 8.
Buteo (*Leucopternis*) *scotopterus* RIDGW. Pr. Boston Soc. N. H. 1873, 64.
Asturina scotoptera SCHLEG. Mus. Pays-Bas, Asturinæ, 1862, 10.

Hab.—Eastern and Northern South America, from Bahia to Bogota (SHARPE).

Wing, 11.60–12.40; tail, 6.80–7.70; culmen, 0.80–0.95; tarsus, 2.90–3.20; middle toe, 1.25–1.35. Fourth quill longest; first shortest. *Adult:*—Head, neck, and entire lower parts white, pure beneath, tinged with ash above; pileum and nape sometimes streaked with black, always (?) with dusky shafts. Above, deep slate, with concealed white spotting. Tail with the basal half dark slate, more or less barred with white on the inner webs, the terminal half white, with a rather narrow subterminal zone of slate.

Young.—"Differs from the adult in having the feathers of the head and neck mesially streaked with slaty-black, the wing-coverts tipped with white, and the white spots on the inner webs of the dorsal feathers more conspicuous."—(SHARPE, *l. c.*)

List of specimens examined.—In mus. Philad. Acad., 2 (Southern Brazil); Am. Mus., N. Y., 1; Boston Soc., 2; total, 5.

LEUCOPTERNIS ALBICOLLIS.

Falco albicollis LATH. Ind. Orn. 1790, 36; Gen. Hist. i, 250.—DAUD. Tr. Orn. ii, 112.
Buteo albicollis GRAY, List B. Brit. Mus. 1848, 38; Gen. fol. 1849, sp. 15.—STRICKL. Orn. Syn. i, 1855, 37.—TAYLOR, Ibis, vi, 1864, 180 (Trinidad and Venez.).—GRAY, Hand List, i, 1869, 8.
Leucopternis albicollis KAUP, Isis, 1847, 210; Contr. Orn. 1850, 78.—BONAP. Consp. i, 1850, 19.—PELZ. Verh. Ges. Wien, 1862, 140; Orn. Bras. 1871, 3, 395.—SCL. & SALV. Ex. Orn. 1868, 122; Nom. Av. Neotrop. 1873, 119.—SALV. Ibis, 1872, 242.—FINSCH, P. Z. S. 1870, 555 (Trinidad).
Buteo (*Leucopternis*) *albicollis* RIDGWAY, Pr. Boston Soc. N. H. 1873, 64.
Tachytriorchis albicollis BONAP. C. R. xli, 1855, 651.
Asturina albicollis SCHL. Mus. P.-B. Asturinæ, 1862, 9.
Urubitinga albicollis SHARPE, Cat. Acc. B. M. 1869, 217.
Falco picatus SHAW, Zoöl. vii, pt. 1, 1809, 167.
Buteo melanotus VIEILL. N. D. iv, 1816, 472.—PUCHER. Rev. et Mag. 1850, 84.
Falco pœcilonotus TEMM. Pl. Col. 9, 1824.
Buteo pœcilonotus VIG. Zoöl. J. i, 1824, 440.—STEPH. Zoöl. xiii, pt. 2, 47.—LESS. Man. i, 104; Tr. Orn. 81.—CUV. Règ. An. ed. 2, i, 337.—GRAY, Gen. fol. 1849, sp. 19.—LÉOT. Ois. Trinid. 1866, 7.
Leucopternis pœcilonotus BONAP. R. Z. 1850, 481; Consp. 19.
White-necked Falcon LATH. Gen. Synop. Suppl. 1787, 30.

Hab.—Northeastern South America, from Northern Brazil to Trinidad and Bogota.

Wing, 13.80–14.60; tail, 8.30–9.00; culmen, 1.00–1.05; tarsus, 2.80–3.25; middle toe, 155. Third to fifth quill longest; first shortest. Prevailing color white, the wings and tail black; back more or less spotted with black, and pileum and nape sometimes streaked with the same. All the feathers of the wings tipped with white. Tail white at the base and end, the middle portion black, this black band of variable width, sometimes occupying the greater portion of the tail, but occasionally (in a specimen from Bogota) restricted to a subterminal band, about 2.50 inches wide.

We have not seen a sufficient number of specimens of this species to enable us to determine whether the remarkable difference in the markings of the tail observed between a Bogota specimen and others from the Amazonian district are sufficiently constant to be of geographical im-

portance. In the specimen in question, the occiput is very distinctly striped with black, instead of being narrowly streaked, or even immaculate.

List of specimens examined.—In mus. Philad. Acad., 4; Boston Soc., 2; total, 6.

LEUCOPTERNIS MELANOPS.

Falco melanops LATH. Ind. Orn. 1790, 37; Gen. Hist. i, 248.—DAUD. Tr. Orn. ii, 117.—SHAW, Zoöl. vii, 175.—TEMM. Pl. Col. i, 1824, 105.
Dædalion melanops VIG. Zoöl. J. i, 1824, 338.—STEPH. Zoöl. xiii, pt. 2, 25.
Astur melanops LESS. Man. i, 1828, 94.—CUV. Règ. An. ed. 2, i, 333.
Buteo melanops GRAY, Gen. fol. 1849, 12, sp. 14; List B. Brit. Mus. 37; Hand List, i, 1869, 8.—STRICKL. Orn. Syn. i, 1855, 36.
Leucopternis melanops KAUP, Isis, 1847, 210; Contr. Orn. 1850, 63.—BONAP. Consp. i, 1850, 19.—PELZ. Verh. Zoöl.-Bot. Ges. Wien, 1862, 140; Orn. Bras. 1871, 3, 395.—SCL. & SALV. Ex. Orn. 1868, 122; Nom. Av. Neotrop. 1873, 119.—SALV. Ibis, 1872, 242.
Buteo (*Leucopternis*) *melanops* RIDGW. Pr. Boston Soc. N. H. 1873, 63.
Asturina melanops SCHL., Mus. Pays-Bas, Asturinæ, 1862, 10.
Urubitinga melanops SHARPE, Cat. Acc. B. M. 1874, 220.

Hab.—Amazonia, including Guiana; Brazil (SHARPE).

Wing, 8.30–9.10; tail, 6.00–6.50; culmen, 0.75–0.80; tarsus, 2.00–2.65; middle toe, 1.25–1.35. Inner webs of only four outer primaries distinctly emarginated; third or fourth quill longest; first shortest. *Adult:*—Head, neck, and entire lower parts white—this sometimes with a beautiful salmon-pink tinge (especially under the wing); lōres, eyelids, and stripe behind the eye black; pileum and nape streaked with black. Upper parts black, the scapulars much spotted with white. Tail black, narrowly tipped with white, and crossed at about one-third the distance from the end by a broad zone of pure white.

List of specimens examined.—In mus. Philad. Acad., 3; Boston Soc., 1; total, 4.

LEUCOPTERNIS KAUPI.

? *Leucopternis kuhli* BONAP. Consp. Av. i, 1850, 19.
Buteo kuhlii GRAY, Hand List, i, 1869, 8.
Buteo (*Leucopternis*) *kuhlii* RIDGW. Pr. Boston Soc. N. H. 1873, 64.
Leucopternis kaupi BONAP. Rev. Zool. 1850, 481.
Buteo kaupi STRICKL. Orn. Syn. i, 1855, 37.
Urubitinga kaupi SHARPE, Cat. Acc. Brit. Mus. 1874, 219.
Leucopternis superciliaris PELZELN, Sitz. Akad. Wien, xliv, 1861, 10; Verh. z.-b. Ges. Wien, 1862, 140; Ueb. Falk. 1862, 7 (Brazil); Orn. Bras. 1871, 3, 395—SCL. & SALV. P. Z. S. 1867, 589; Ex. Orn. pt. v, 1867, pl. xxxviii; pt. viii, 1868, 122; Nom. Neotr. 1873, 119.—SALV. Ibis 1872, 242.
Asturina superciliaris SCHLEG. Mus. Pays Bas, Asturinæ, 1862, 12.

Hab.—Amazonia, and "Brazil, in the vicinity of Para" (SHARPE).

Wing, 8.40–8.70; tail, 5.30–6.20; culmen, 0.80–0.85; tarsus, 2.10–2.40; middle toe, 1.25–1.30. Fourth to fifth quills longest; first shortest. *Adult:*—Above dark slate; the nape, and sometimes the pileum, streaked with white. Beneath entirely white; the sides of the neck and breast streaked with black. Tail dark slate, faintly whitish at the tip, and crossed a little beyond the middle by a narrow zone of white.

List of specimens examined.—In mus. Philad. Acad., 2; Boston Soc., 1; total, 3.

LEUCOPTERNIS SEMIPLUMBEUS.

Leucopternis semiplumbeus LAWR. Ann. N. Y. Lyc. vii, 1861, 283; *ib.* ix. 1868, 133.—SCL. & SALV. Ex. Orn. 1868, 121, pl. lxi; Nom. Neotrop. 1869, 119.—SALV. Ibis, 1872, 243.
Buteo semiplumbeus GRAY, Hand List, i, 1869, 9.
Urubitinga semiplumbea SHARPE, Cat. Acc. B. M. 1874, 220.

Wing, 7.20–8.70; tail, 5.00–7.80; culmen, 0.70–0.85; tarsus, 2.20–2.45;

middle toe, 1.25–1.35. Inner webs of only four outer primaries distinctly emarginated; third to fifth quills longest; first shortest. Tail nearly even, the lateral pair of feathers slightly the shortest. *Adult:*—Entire upper surface, including the side of the head and neck, uniform dark plumbeous. Tail black, crossed at a little beyond the middle by a narrow, continuous band of whte, and sometimes with a second, less continuous, band, nearer the base. Entire lower parts, including the chin and throat and lining of the wing, continuous pure white, the sides of the breast, and sometimes the throat, with a few fine shaft-streaks of dusky. Inner webs of the primaries ashy, barred with dusky beyond their sinuations. Bill slate-black, the basal two-thirds of the lower mandible and that portion of the upper below the cere pale yellow; cere, rictus, and base of lower mandible bright orange-red; tarsi and toes deep reddish-orange; claws black.

The variations in the plumage of this species consist mainly in the presence or absence, and amount when present, of plumbeous wash on the outer side of the tibiæ, and the streaks of the same on the throat. In No. 64943, the outer side of the tibiæ is almost wholly plumbeous, while in No. 66334 it is entirely absent; in the former, each feather of the throat has a distinct dusky shaft-streak, while in the latter the throat is immaculate. Other specimens are variously intermediate between these extremes.

No. 66334 differs from all others examined in having two bands on the tail, instead of only one; these are both well defined, though the anterior one is not, like the posterior one, continuous. No other differences, however, can be detected, while in other specimens this second band is found indicated by transverse white spots on the inner webs.

List of specimens in United States National Museum.

Catalogue No.	Original No.	Sex and age.	Locality.	When collected.	From whom received.
47364	.....	♂ ad.	Costa Rica	April 4, 1867	J. Carmiol.
64941	562	— ad.	.....do	—— —, 1873	Prof. Wm. M. Gabb.
64942	160	♂ ad.	.....do	—— —, 1873	Do.
64943	552	♀ ad.	.....do	—— —, 1873	Do.
66334	.....	— ad.	.....do	—— —, 1873	Do.
66335	35	— ad.	Costa Rica (Old Harbor)	—— —, 1873	Do.
67860	265	♂ ad.	Costa Rica (Talamanca)	.....	Do.
67863	.....	— ad.	.....do	.....	Do.
67864	205	♀ ad.	.....do	.....	Do.

Other specimens examind.—In mus. G. N. Lawrence, 3 (Panama); R. Ridgway, 1 (Costa Rica); total, 13.

LEUCOPTERNIS PRINCEPS.

Leucopternis princeps Scl. & Salv. P. Z. S. 1865, 429, pl. xxiv; Ex. Orn. 1868, 122; Nomencl. Neot. 1873, 119.—Lawr. Ann. Lyc. N. Y. ix, 1868, 133.—Salv. Ibis, 1872, 241-243.

Buteo princeps Gray, Hand List, i, 1869, 9.

Urubitinga princeps Sharpe, Cat. Acc. Brit. Mus. 1874, 220.

Hab.—Costa Rica (mountainous districts).

Wing, 14.00–15.20; tail, 7.50–9.00; tarsus, 3.25–3.80; middle toe, 2.90. Fourth quill longest, the fifth scarcely shorter; first 3.50 shorter than the

fourth. *Adult:*—Head, neck, jugulum, and entire upper parts uniform plumbeous-black, the bases of the feathers pure white; this somewhat exposed on the occiput and nape. Tail deep black, crossed at about the middle of its exposed portion by a narrow zone of white, and anterior to this by narrower and less complete bands of the same. Lower parts, from the jugulum back, white, narrowly barred with black over the entire surface.

This very rare, and, so far as regards the coloration of the lower parts, somewhat aberrant, species, we have not seen, and consequently draw up our diagnosis from the characters furnished by its describers.

GENUS ELANOIDES, VIEILLOT.

Elanoides VIEILLOT, Nouv. Dict. d'Hist. Nat. xxiv, 1818, 101. Type, *Falco forficatus* LINN.
Nauclerus AUCT., *nec* VIGORS, 1825.

*Osteological characters.**—Cranium very similar in contour and proportions to that of *Pandion*, but presenting important modifications in minor details. Superciliary process of the lachrymal distinct from the frontal, which is completely anchylosed with the nasal; inner convoluted edge of the palatines scarcely produced downward; nasal septum completely ossified; pterygoïd bone narrow, and of a uniform width throughout its length. Sternum similar to that of *Pandion*, having, like it, a pair of indentations on the posterior margin, and destitute of foramina; the clavicle, coracoids, and scapula are also very similar.

Anatomical characters.—"Palate flat with two longitudinal ridges; upper mandible with a tuberculate median ridge, lower deeply concave; posterior aperture of the nares oblongo-linear, with the edges papillate. Tongue somewhat decurved, emarginate, and finely papillate at the base, flat above, its tip narrow and acutely emarginate. Œsophagus of nearly uniform width, being destitute of crop, and thus resembling that of the owls; its walls extremely thin; stomach very large, round, slightly compressed, its muscular coat very thin, and composed of a single series of fasciculi. Intestine short and rather wide; pylorus with three knobs, duodenum forming a loop in the usual manner; no cæca; rectum short, with a large globular dilatation."—(MCGILLIVRAY.)

Pterylographical characters.—"Inner branch on the jugular part distinct but short; outer branch entirely free. Dorsal portion of the spinal tract usually long."†—(NITZSCH.) Contour-feathers with aftershafts. Lumbar tract present. Remiges, 23.

General external characters.—Bill rather small and narrow, intermediate between that of *Pandion* and *Elanus;* compressed anteriorly, and very broad at the base; the terminal hook well produced, the tomia very regular; cere ascending; nostril broadly oval, oblique; gonys nearly straight; tomium of the lower mandible very convex. Lores densely feathered, the feathers bristle-like. Feet robust; tarsus a little longer than the middle toe, covered with large, irregular, hexagonal scales; toes with transverse scutellæ nearly to the base; claws short, strong, abruptly flattened beneath, the edges very sharp, the middle claw bent laterally, the inner side very convex, the projecting edge sharp and entire. No web between the toes. Primaries and rectrices excessively elongated and narrow, the former more than twice the length of the secondaries. Outer tail-feathers about equal to the primaries, and more than twice as long as the middle pair.

Apparently more nearly related to *Pernis*, *Cymindis*, *Regerhinus*, and allied forms than to any other genera, the genus *Elanoides* yet stands isolated from these by the absence of many characters common to them, and by the possession of features peculiarly its own. In general external form, it approaches quite nearly the genus *Milvus*, but when com-

* Of this genus we have seen only the skull and sternum.

† NITZSCH gives the above characters of a group in which he includes *Milvus regalis*, *M. ater*, and *Elanoides forficatus*.

pared closely, the two are found to possess no real affinities of structure. The same is true of its relation to *Nauclerus riocouri*, usually placed in the same genus; the latter being very much more intimately related to the genera *Ictinia*, *Elanus*, and their affines, as shown on page 147.

ELANOIDES FORFICATUS.

Falco forficatus LINN. S. N. i, 1758, 89.

Nauclerus forficatus RIDGW. Pr. Phil. Ac. Dec. 1870, 144; Pr. Boston Soc. N. H. May, 1873, 52; Am. Nat. vii, April, 1873, p —; B. B. & R. Hist. N. Am. B. iii, 1874, 192.

Falco furcatus LINN. S. N. i, 1766, 129.—GM. S. N. i, 1788, 262.—LATHAM, Ind. Orn. i, 1790, 22.—SHAW & NODD. Nat. Misc. 1795, pl. 204.—DAUD. Tr. ii, 1800, 152.—SHAW, Zoöl. vii, 1812, 107.—WILS. Am. Orn. vi, 1812, 70, pl. 51, figs. 1, 3.—BONAP. Ann. N. Y. Lyc. ii, 1828, 31; Isis, 1832, 1138.—AUD. B. Am. 1831, pl. 72; Orn. Biog. i, 1831, 368; v, 371.—SCHL. u. susem. Vög. Eur. 1839, taf. 32, f. 1.

Milvus furcatus VIEILL. O. Am. S. 1807, pl. x.

Elanoides furcatus VIEILL. Enc. Méth. iii, 1823, 1205.—GRAY, List. Acc. B. M. 1844, 44.—STRICKL. Orn. Syn. i, 1855, 141.—SCL. & SALV. Ibis, 1859, 220; Nom. Neotr. 1873, 121.—OWEN, Ibis, 1860, 240.—SCHL. Mus. P.-B. Milvi, 1862, 5.—SHARPE, Cat. Acc. B. M. 1874, 317.

Elanus furcatus VIG. Zoöl. Journ. i, 1824, 340.—STEPH. Zoöl. xiii, 1826, 49, pl. ii.—CUV. Règ. An. ed. 2, i, 1829, 334.—JAMES. ed. Wils. Am. Orn. i, 1831, 75.—JARD. ed. Wils. ii, 1832, 275.—NUTT. Man. 1833, 94.

Nauclerus furcatus VIG. Zoöl. Journ. ii, 1825, 387; Isis, 1830, 1043.—LESS. Man. i, 1828, 101; Traité, 1831, 73.—SWAINS. Classif. i, 1837, 312; ii, 210.—GOULD, B. Eur. 1837, pl. xxx.—BONAP. Comp. List, 1838, 4; Cat. Ucc. Eur. 1842, 20; Consp. i, 1850, 21.—AUD. B. Am. fol. 1839, pl. 72; oct. ed. 1839, i, 78, pl. 18; synop. 1839, 14.—R. SCHOMB. Reis. Br. Guian. 1840, 735.—DE KAY, Zoöl. N. Y. ii. 1844, 12, pl. vii, f. 15.—GRAY, Gen. i, 1845, 25, pl. 9, fig. 9; Gen. & Subgen. B. M. 1855, 6; Hand List, i, 1869, 27.—HARTL. Ind. Azara, 1847, 57.—KAUP, Contr. Orn. 1850, 57.—BREWER, ed. Wils. Synop. 1852, 685; N. Am. Oölogy, i, 1857, 38.—WOODH. Expl. Zuñi, 1853, 60.—BURM. Th. Bras. ii, 1856, 110.—CASS. B. N. Am. 1858, 36.—BAIRD, Cat. N. Am. B. 1859, No. 34.—TAYLOR, Ibis, iv, 1862, 128.—DRESSER, Ibis, 1865, 325.—COUES, Pr. Phil. Acad. 1866, p. —; Key N. Am. B. 1872, 211; Check List N. Am. B. 1873, 67; Birds Northwest, 1874, 332.—LÉOT. Ois. Trinid. 1866, 30.—GUNDL. J. f. O. 1871, 370.—NEWT. ed. Yarr. Br. B. 1871, 103.—PELZ. Orn. Bras. 1871, 6, 398.

Elanoides yetapa VIEILL. Enc. Méth. iii, 1823, 1205.

Falco yetapa MAX. Beitr. iii, Abth. i, 1830, 141.

Accipiter cauda furcata CATESBY, N. H. Carol. i, 1754, pl. iv.

Accipiter milvus carolinensis BRISS. Orn. i, 1760, 418.

The Swallow-tailed Hawk CATESBY, Carol. i, 1731, 4, pl. 4.

Le Milan de la Caroline BRISS. Orn. i, 1760, 418.

Swallow-tailed Falcon LATHAM, Synop. i, 1781, 60.—PENNANT, Arc. Zoöl. ii, 1785, 210, No. 108, pl. x.

Hab.—The whole of tropical and subtropical America, south to Paraguay, Buenos Ayres, and Chile, north in the interior districts of the United States to Minnesota and Wisconsin, and in the Atlantic States to Pennsylvania. Accidental in the British islands (NAT. MUS.!); Minnesota, 30 miles north of Mille Lac, lat. 47° (TRIPPE, Pr. Essex Inst., vi, 1871, 113).

Wing, 15.40–17.70; tail, 12.50–14.50; culmen, 0.70–0.80; tarsus, 1.00–1.30; middle toe, 1.00–1.20. Head, neck, entire lower parts (including lining of the wing and basal half of the secondaries underneath), and band across the rump pure white. Back, wings, and tail plain polished blackish, with varying reflections; tertials white, with blackish tips. *Adult:*—The white of the head and neck immaculate; back scapulars and lesser wing-coverts with a soft reflection of dark purplish bronze, the other black portions with a glaucous or chalky cast, with a green reflection in certain lights. *Young:*—Feathers of the head and neck with dusky shaft-streaks; the black above less glossy, more brownish, the bottle-green reflection replacing the soft purplish bronze on the

back and shoulders; remiges, rectrices, and primary coverts with a narrow terminal border of white.

There is little variation in the coloration of this beautiful species, the only one presenting differences particularly noticeable being No. 56099 (supposed to be from England), in which the black in its entire extent is nearly uniform, and glossed with a uniform violaceous-slate. This appearance, however, is probably caused by greater age of the feathers.

The fresh colors of the soft parts are as follows in the adult:—"Bill deep black, the basal half of the lower mandible, the basal portion of the upper beneath the cere, the cere, rictus, and naked eyelids, plumbeous-blue; feet similar but paler; claws grayish brown; *iris very dark brown:* interior of the mouth bright cobalt-blue." (No. 957, ♂, Mus. R. R., Mt. Carmel, Ill., Aug. 1, 1870. Length, 22.75; extent, 50.80.)

List of specimens in United States National Museum.

Catalogue No.	Original No.	Sex and age.	Locality.	Date.	Donor.
3754	.....	.....	Prairie Mer Rouge, La	.....	James Fairie.
12035	.....	♂ ad.	Cantonm't Burgwyn, N. Mex.	Aug. 5, 1859	W. W. Anderson.
18457	.....	— juv.	Cherokee Nation, Ind. T.	Aug. 5, 1849	Dr. Woodhouse.
30408	40	— ad.	Costa Rica (San José)	.....	Dr. A. von Frantzius.
34151	13	♀ ad.	Sioux City, Iowa	May 5, 1864	John Feilner.
39332	40	♂ ad.	Costa Rica	May 15, 1865	Dr. A. von Frantzius.
39451	.....	— ad.	Eastern Peru (head Hualaga River).	.....	Walter T. Church.
41906	38	♂ ad.	Western Kansas	.....	Allen Crocker.
50928	.....	— ad.	Brazil	.....	Sr. Don Fr. Albuquerque.
51654	.....	♀ ad.	Texas (Washington County)	.....	G. W. Lincecum.
52993	.....	— ad.	Kiowa Agency, Ind. T	.....	Dr. E. Palmer.
56099	73	♂ ad.	"In Englang geschossen"	.....	W. Schlütter.
56100	74	♀ ad.	..... do	.....	Do.

Other specimens examined.—In mus. Philad. Acad., 3; Am. Mus., N. Y., 4 (Brazil); Boston Soc., 1; Mus. Comp. Zoöl., 2; G. N. Lawrence, 3; R. Ridgway, 2 (Illinois and Demerara); total, 28.

Collectors' notes.—No. 34151: length, 23.20; extent, 56.20. No. 39332: "Iris red." J. Zeledon.

ORNITHOLOGY OF GUADELOUPE ISLAND, BASED ON NOTES AND COLLECTIONS MADE BY DR. EDWARD PALMER.

By Robert Ridgway.

The small collection of birds transmitted to the National Museum by Dr. Palmer is very interesting, from the fact that every one of the resident species is distinct from any found on the neighboring main-land, although each has a continental representative more or less nearly related. The collection is said to include all the species of land-birds found on the island, with the exception of a humming-bird, a hawk, and two kinds of owls, no specimens of which were obtained.

While the peculiar *facies* of this local insular fauna is very strongly marked, it is a noteworthy fact that among the *Passeres*, when there is any similarity to continental forms, the closest resemblance is to the Rocky Mountain or Middle Province races, instead of those of the neighboring Pacific coast. Thus, the *Junco*, the *Thryomanes*, and the *Carpodacus* are much more like *J. annectens*, *T. bewicki leucogaster*, and *C. frontalis frontalis* than *J. oregonus*, *T. bewicki spilurus*, and *C. frontalis rhodocolpus* of the coast district. It is still more remarkable that the *Polyborus* should, while distinct from either, be more like the species from southern South America (*P. tharus*) than that from Lower California and other portions of Middle America (*P. cheriway*).

It is much to be regretted that the notes accompanying the specimens are so meagre; they only furnish the information that the position of Guadeloupe is between latitude 28° 45′ and 29° 10′ north, and off the coast of Lower California, two hundred and twenty miles southwest from San Diego.

The land-birds ascertained by Dr. Palmer to inhabit the island during the breeding-season are the following:—

Fam. Sylviidæ.

1. Regulus calendula obscurus *nobis*.

Fam. Troglodytidæ.

2. Salpinctes obsoletus guadeloupensis *nobis*.
3. Thryomanes brevicauda *nobis*.

Fam. Fringillidæ.

4. Carpodacus amplus *nobis*.
5. Junco insularis *nobis*.
6. Pipilo maculatus consobrinus *nobis*.

Fam. Trochilidæ.

7. ——? (Unidentified.)

Fam. PICIDÆ.

8. Colaptes mexicanus rufipileus *nobis.*

Fam. STRIGIDÆ.

9. ——— ? } (Unidentified.)
10. ——— ? }

Fam. FALCONIDÆ.

11. Polyborus lutosus *nobis.*

FAM. SYLVIIDÆ.

1. REGULUS CALENDULA OBSCURUS, *nobis.*

CH.—*Adult:*—Above olive-gray, with a slight greenish cast, the primaries and tail-feathers edged with dull sulphur-yellow; both rows of wing-coverts tipped with dull grayish-white, forming two well defined bands. A distinct, broad, dull-white, orbital ring. Lower parts pale grayish-buff, the sides slightly tinged with olivaceous. *Male*, crown with a large central patch of vermilion-red, concealed or exposed at pleasure; wing, 2.15–2.20; tail, 1.85–1.95; bill, 0.25; tarsus, 0.80; middle toe, 0.38–0.40. *Female*, without the red on the crown; wing, 2.00; tail, 1.70; bill, 0.22; tarsus, 0.80; middle toe, 0.40.

Remarks.—This resident insular race of the Ruby-crowned Kinglet differs very appreciably from the continental form in the considerably darker, more plumbeous shade of the upper surface, the larger bill, and rather shorter wings and tail; the tarsis and toes are also appreciably longer. The differences may be more precisely expressed by the following table of comparative characters:—

R. CALENDULA OBSCURUS.—Wing, 2.00–2.20; tail, 1.70–1.95; bill, 0.22–0.25; tarsus, 0.80; middle toe, 0.38–0.40. Upper parts dusky brownish-gray anteriorly. *Hab.*—Guadeloupe Island.

R. CALENDULA CALENDULA.—Wing, 2.20–2.30; tail, 1.85–1.90; bill, 0.20–0.22; tarsus, 0.75; middle toe, 0.35. Upper parts light olivaceous-gray anteriorly. *Hab.*—North America in general (continental).

The comparative measurements of the two races are as follows:—

R. OBSCURUS.

Catalogue No.	Original No.	Sex and age.	Wing.	Tail.	Bill.*	Tarsus.	Middle toe.
70036	36	♂ ad.	2.15	1.85	0.25	0.80	0.38
70037	36	♂ ad.	2.15	1.85	0.25	0.80	....
70038	36	♂ ad.	2.20	1.95	0.25	0.80	....
70039	36	♂ ad.	2.20	1.95	.....	.....	....
70040	37	♀ ad.	2.00	1.70	0.22	0.80	0.40

* The bill is measured from the anterior portion of the nostril, and not from the base of the culmen.

R. CALENDULA.

Catalogue No.	Sex and age.	Locality.	Wing.	Tail.	Bill.	Tarsus.	Middle toe.
1993, Mus. R. R	♂ ad.	Alaska..	2.30	1.90	0.22	0.75	0.35
1430, Mus. R. R	♀ ad.	Illinois..	2.20	1.85	0.20	0.75	0.35

Collector's notes.

First seen April 1. During the winter, the bird was not seen on the middle or northern portions of the island, but is supposed to remain in the warmer cañons, whence it becomes generally distributed during March. A male, closely observed during the act of singing, was seen to display the red of the crown to its full extent; this conspicuous ornament being concealed again as soon as the notes closed.

FAM. TROGLODYTIDÆ.

2. SALPINCTES OBSOLETUS GUADELOUPENSIS, *nobis.*

CH.—*Adult:*—Above dull grayish-brown, indistinctly speckled with dusky, and becoming light cinnamon-rufous on the rump; wings and tail indistinctly barred with dusky; tail-feathers, except the middle pair, broadly tipped with pale cinnamon, this preceded by a less regular and more broken black bar; the cinnamon frequently finely mottled with dusky. Chin, throat, and jugulum dull white, the jugulum distinctly streaked with dusky; rest of lower parts nearly plain dirty white, becoming light pinkish-cinnamon on the sides; crissum heavily barred with black. *Male*, wing, 2.60–2.75; tail, 2.20–2.30; bill, 0.58–0.60; tarsus, 0.80–0.90; middle toe, 0.50–0.55. *Female*, wing, 2.50–2.60; tail, 2.00–2.20; bill, 0.55–0.60; tarsus, 0.80–0.90; middle toe, 0.50–0.55.

Remarks.—The upper tail-coverts are strongly barred transversely. There is a tolerably well-defined light superciliary stripe. In No. 70049, there is a deep reddish-brown suffusion across the breast, apparently an accidental stain from contact with ferruginous earth. The differences exhibited in these insular specimens from the continental series are quite slight, but they are so constant as to demand recognition. As to colors, there is no difference beyond slightly darker shades throughout; the lower parts being soft pinkish cream-color instead of creamy-white, the other portions of a darker shade to correspond. The differences in proportions are more decided, as may be seen from the following figures:—

S. GUADELOUPENSIS.

Mus. No.	Original No.	Sex and age.	Wing.	Tail.	Bill.*	Tarsus.	Middle toe.
70043	13	♂ ad.	2.75	2.30	0.60	0.90	0.55
70044	13	♂ ad.	2.70	2.20	0.60	0.80	0.55
70045	13	♂ ad.	2.60	2.30	0.58	0.85	0.50
70046	.....	♀ ad.	2.55	2.15	0.60	0.85	0.50
70047	14	♀ ad.	2.60	2.00	0.55	0.80	0.50
70048	14	♀ ad.	2.60	2.15	0.60	0.85	0.52
70049	14	♀ ad.	2.55	2.15	0.58	0.90	0.50
70050	14	— ad.	2.60	2.25	0.60	0.90	0.50
70051	28	♀ ad.	2.60	2.20	0.55	0.85	0.55
70052	38	♀ ad.	2.50	2.00	0.55	0.85	0.50

S. OBSOLETUS.

Mus. R. R. No.	Original No.	Age and sex.	Locality.	Date.	Wing.	Tail.	Bill.*	Tarsus.	Middle toe.
17	.....	♂ ad.	Nevada	Mar. 25, —	2.90	2.40	0.50	0.90	0.55
.....	17a	♂ ad.	New Mexico	June 22, —	2.90	2.40	0.50	0.85	0.58

* From nostril.

Collector's notes.

Eyes brown. Stomach contained caterpillars and other insects. These birds are generally distributed over the island, but are found especially in the sheltered cañons of the middle portion, where they are numerous. They also frequent the slaughter-yards, where goats are killed, to glean insects from the drying bones. Their notes are often heard early in the morning, when the birds mount some prominent rock or stump. Their general habits are not peculiar. April 5, 1875, a female was taken, with the nest and eggs. The nest was built on the ground, beneath a rock, which sheltered it from the prevailing winds; it was lined with goat's hair, and contained two fresh eggs; a third, nearly ready to be laid, was found on opening the bird. Another nest, containing three eggs, was found in a crevice of a large rock, some 5 feet high. The fissure was about 18 inches deep; and being more capacious than was necessary for accommodation of the nest, was divided by a partition, which the birds had built across it, leaving an interior space for the nest, and an aperture just large enough for the birds to pass with ease. This partition, which effectually blocked up the passage to the nest, was composed of pebbles. A third nest was discovered so far under a large solid rock, and with so small an entrance, that it could not be secured. The passage to this nest was also blocked with small stones.

3. THRYOMANES BREVICAUDA, *nobis.*

SP. CH.—*Adult*:—Above grayish hair-brown, brownest on the rump, grayest on the tail; remiges just perceptibly, and tail-feathers very distinctly, transversely barred with dusky; three lateral tail-feathers light dull gray terminally, with one or two broad dusky bars across the anterior portion of the gray. A very conspicuous white superciliary stripe from the nostril to the occiput; below this a grayish-brown stripe, covering the lore and widening on the upper posterior portion of the auriculars. Lower parts white anteriorly, passing gradually into dull ash-gray on the sides and abdomen; crissum broadly barred with black. Wing, 1.85–1.90; tail, 1.80; bill, 0.45–0.50; tarsus, 0.70–0.75; middle toe, 0.50.

Remarks.—This Wren appears to bear about the same relation to *T. bewicki leucogaster* that *Junco insularis* does to *J. annectens;* and it is a curious fact that the analogue of each should be the form from the interior of the continent instead of that from the neighboring coast. This insular form is much grayer than the *T. bewicki spilurus* of California and Western Mexico, and presents other decided differences from all the continental forms. The following measurements of specimens of the two forms show how greatly they differ in dimensions and proportions; the difference from *T. bewicki leucogaster* is still more conspicuous.

T. BREVICAUDA.

Nat. Museum No.	Original No.	Age and sex.	Wing.	Tail.	Bill.*	Tarsus.	Middle toe.
70041	15	.....	1.90	1.80	0.50	0.70	0.50
70042	15	.....	1.85	1.80	0.45	0.75	0.50

T. BEWICKI SPILURUS.

249	.....	.....	2.00	2.00	0.40	0.80	0.45
1276	.....	.....	2.30	2.50	0.40	0.80	0.48

* From nostril.

Collector's notes.

Iris brown. Stomach contained remnants of some small black insects which feed upon the blossoms of the White Sage. The bird is resident upon the island, but not numerous. Their motions are very quick; their general habits restless, impatient, and shy. Their almost incessant activity, together with their shyness, renders them difficult to secure. They live in the brush, being rarely seen on trees.

FAM. FRINGILLIDÆ.

4. CARPODACUS AMPLUS, *nobis.*

SP. CH.—*Adult:*—Above, bark brownish-gray, the feathers indistinctly darker centrally, the wing- and tail-feathers edged with paler brownish-gray. Lower parts dull white, conspicuously streaked with brownish-gray. *Male*, frontal band (about 0.15–0.30 wide), superciliary stripe back to the ends of the auriculars, cheeks (anterior half of the maxillary region), chin, throat, breast, and patch on lower part of the rump bright crimson. Wing, 3.30–3.35; tail, 2.80–2.90; bill, from nostril, 0.42–0.45; depth of bill, 0.42–0.50; breadth of bill, 0.32–0.35; tarsus, 0.80; middle toe, 0.60–0.65. *Female*, lacking the red, each feather of the lower parts having a distinct central streak. Wing, 3.10–3.25; tail, 2.60–2.90; length of bill, 0.40–0.45; depth, 0.40–0.48; breadth, 0.32–0.38; tarsus, 0.75–0.85; middle toe, 0.58–0.65. *Young:*—Similar in plumage to the adult female, but light edges to wing- and tail-feathers broader and more inclining to fulvous.

Remarks.—The upper mandible is nearly black, the lower much lighter, a purplish horn-color in the male, almost white in the female; the feet are brownish-black. In the male, the back is just appreciably glossed with a faint red tinge, and the shade of the red markings varies from a deep harsh carmine or true crimson to almost a red-lead hue. The coloration is exactly like that of *C. frontalis* from the Rocky Mountains, except that the tints are all darker; but the size is in every way so much greater that no comparison is needed, as the following measurements will demonstrate.

C. AMPLUS.—Wing, 3.10–3.35; tail, 2.60–2.90; bill, 0.40–0.45 from nostril, 0.40–0.50 deep, 0.32–0.38 wide; tarsus, 0.75–0.85; middle toe, 0.58–0.65.

C. FRONTALIS.—Wing, 2.85–3.10; tail, 2.50–2.80; bill, 0.30–0.35 from nostril, 0.30 deep, 0.25–0.27 wide; tarsus, 0.65–0.70; middle toe, 0.50.

C. AMPLUS.

Catalogue No.	Original No.	Sex and age.	Wing.	Tail.	Length of bill.*	Depth of bill.	Breadth of bill.	Tarsus.	Middle toe.
70004	8	♂ ad.	3.30	2.90	0.45	0.42	0.32	0.80	0.60
70005	8	♂ ad.	3.35	2.80	0.42	0.45	0.32	0.80	0.62
70006	8	♂ ad.	3.30	2.85	0.42	0.45	0.35	0.80	0.65
70007	8	♂ ad.	3.35	2.90	0.45	0.50	0.35	0.80	0.65
70008	8	♂ ad.	3.30	2.85	0.42	0.50	0.35	0.80	0.65
70009	8	♂ ad.	3.30	2.90	0.45	0.48	0.35	0.80	0.62
70010	7	♀ ad.	3.10	2.60	0.40	0.40	0.32	0.75	0.58
70011	7	♀ ad.	3.20	2.75	0.45	0.45	0.35	0.85	0.65
70012	7	♀ ad.	3.25	2.90	0.45	0.48	0.38	0.80	0.60
70013	39	— juv.	.....	.....	.....	.....	.....	.....	.....
70014	40	— juv.	.....	.....	.....	.....	.....	.....	.....

* From nostril.

C. FRONTALIS.

Catalogue No., Mus. R. R.	Sex and age.	Locality.	Date.	Wing.	Tail.	Length of bill.	Depth of bill.	Breadth of bill.	Tarsus.	Middle toe.
51	♂ ad.	Utah	June 7, ——	3.10	2.80	0.30	0.30	0.25	0.65	0.50
346	♀ ad.	Cape St. Lucas	Dec. 3, ——	2.85	2.50	0.35	0.30	0.27	0.70	0.50

Collector's notes.

Iris brown. Legs purplish dusky. Bill of the newly-fledged birds greenish-yellow below. This bird is very numerous during winter in the warm cañons of the central and southern portions of the island. They feed extensively upon soft buds and tender vegetation generally, as well as upon seeds, and are destructive to the grain, which they husk out of its envelope in the same manner as Canarybirds do. During winter, they avoid the vicinity of dwelling-houses, but in summer can scarcely be kept out. During warm afternoons, they often congregate about the springs to bathe. This is the principal songster of the island; the notes are fine, and quite equal to those of the Canary. Newly-fledged young were taken May 5. A completed nest, though without eggs, was found April 21; it was in the crevice of a rock, shaded and hidden by shrubbery. The parents deserted it in consequence of my visit.

5. JUNCO INSULARIS, *nobis.*

SP. CH.—*Adult:*—Head, neck, jugulum, and upper parts gray, the tint of a light ash hue on the gular region, dark slate on the pileum, overlaid with a wash of hair-brown on the back and wings, and becoming almost black on the lores. Lower parts white medially; the entire sides light cinnamon. Three lateral tail-feathers with white patches, on the outer occupying most of the feather; on the third reduced to an elongated spot on the inner web. *Male*, wing, 2.70–2.85; tail, 2.50–2,60; bill, 0.35–0.38; depth, 0.25–0.27; tarsus, 0.80–0.85; middle toe, 0.55–0.60. *Female*, wing, 2.50–2.65; tail, 2.30–2.45; bill, 0.35–0.38; depth, 0.25; tarsus, 0.80–0.85; middle toe, 0.55–0.60. *Young:*—Above, brownish-gray, browner on the back, the feathers indistinctly streaked centrally with dusky; wing-coverts indistinctly tipped with pale fulvous-gray; jugulum and sides light grayish-fulvous, marked with cuneate streaks of dusky; throat pale ashy, more indistinctly streaked; abdomen dull white, without streaks; bill wholly blackish.

Remarks.—This very curious species resembles most closely in colors the *J. annectens* of the Rocky Mountains, the similarity being very great. The form and relative proportions, however, are so different that we have no hesitation in pronouncing it a very distinct species. The colors of the lower parts are exactly as in *J. annectens*, except that the lower tail-coverts, instead of being entirely white for the exposed portion, are dusky, merely bordered with dirty white. The wings and back are the same color as in *annectens*, but the nape and top of the head are considerably darker, being dusky slate instead of clear plumbeous. The comparative characters of the two species may be expressed as follows:—

J. INSULARIS.—Wing, 2.55–2.85; tail, 2.30–2.60; bill, 0.35–0.38; its

depth, 0.25–0.27; tarsus, 0.80–0.85; middle toe, 0.55–0.60. Crown and nape dark slate. Lower tail-coverts dusky, bordered with dirty white. *Hab.*—Guadeloupe Island.

J. ANNECTENS.—Wing, 3.00–3.25; tail, 2.80–3.40; bill, 0.30; its depth, 0.20; tarsus, 0.80; middle toe, 0.55–0.60. Crown and nape clear plumbeous. Lower tail-coverts pure white, dusky beneath surface only. *Hab.*—Rocky Mountains (Middle Province) of the United States.

J. INSULARIS.

Nat. Mus. No.	Original No.	Sex and age.	Wing.	Tail.	Length of bill.*	Depth of bill.	Tarsus.	Middle toe.
70015	10	♂ ad.	2.85	2.60	0.38	0.25	0.85	0.55
70016	10	♂ ad.	2.70	2.60	0.35	0.25	0.85	0.55
70017	10	♂ ad.	2.70	2.50	0.35	0.25	0.80	0.55
70018	10	♂ ad.	2.75	2.55	0.35	0.27	0.85	0.60
70020	9	♀ ad.	2.50	2.40	0.35	0.25	0.82	0.58
70021	9	♀ ad.	2.60	2.40	0.35	0.25	0.80	0.55
70022	9	♀ ad.	2.60	2.30	0.35	0.25	0.82	0.55
70023	9	♀ ad.	2.55	2.45	0.38	0.25	0.85	0.60
70024	9	♀ ad.	2.65	2.40	0.38	0.25	0.80	0.55
70025	35	— ad.	2.55	2.45	0.35	0.25	0.80	0.55
70026	79	— juv.	.....	.....	.....	.....	.....	.....
70027	49	— juv.	.....	.....	.....	.....	.....	.....

* From nostril.

J. ANNECTENS.

No. Mus. R. R.	Sex and age.	Locality.	Date.	Wing.	Tail.	Length of bill.	Depth of bill.	Tarsus.	Middle toe.
415	♂ ad.	Arizona....	Nov. 2, ——	3.25	3.40	0.30	0.20	0.80	0.60
417	♀ ad.	Wyoming..	May 28, ——	3.00	2.80	0.30	0.20	0.80	0.55

Collector's notes.

Iris brown. These are the most abundant birds of the island, and are so tame that they may be killed with a stick, or captured in a butterfly-net. While I was looking for insects under stones and logs, these birds would sometimes join in the search, and hop almost into my hands. They gathered chiefly ants and their eggs. At times, they even enter the houses, picking up anything edible they can find. Numbers boarded the schooner as we neared the island, and made themselves perfectly at home, roaming over every part of the vessel in search of food. Like the Linnets (*Carpodacus*), they are fond of bathing in the springs during warm weather. In flight, the tail is spread, displaying the white lateral feathers; and when angry, the whole plumage is ruffled. A nest with eggs was found April 12, on the summit of Mount Augusta, the highest point of the island, altitude 3,500. It was placed in a small crevice in the face of a rock.

6. PIPILO MACULATUS CONSOBRINUS, *nobis*.

CH.—*Adult male:*—Head, neck, jugulum, and entire upper parts black; outer webs of scapulars white, usually narrowly bordered with black; both rows of wing-coverts tipped with white, forming two well-defined bands; tertials and middle portion of primaries slightly edged with white; inner webs of two or three lateral tail-feathers with a terminal

white patch, about 0.75–0.90 wide on the outer feather, the outer web of which is also edged with white. Lower parts white medially, the entire sides deep rufous; crissum ochraceous. Wing, 3.10–3.25; tail, 3.50–3.80; bill, 0.38–0.40; tarsus, 1.05–1.10; middle toe, 0.70–0.75; hind claw, 0.50–0.55. *Adult female:*—Similar in plumage to the male, but the deep black replaced by dull brownish-black; white spots on the tail-feathers more restricted. Wing, 2.90–2.95; tail, 3.25–3.65; bill, 0.35–0.40; tarsus, 1.00–1.05; middle toe, 0.60–0.65; hind claw, 0.50–0.55.

Remarks.—The feathers of the gular region are ash-gray or light plumbeous at their roots; there is no indication of white on the side of the forehead nor on the base of the primaries; the feathers between the rufous of the sides and the white below it have longitudinal black spots in every specimen.

This race is somewhat intermediate between *P. oregonus* and *P. carmani*, but seems to be most like the latter. The sexes are more nearly alike than in any other of the races of *P. maculatus*, the female being as dark as, if not darker than, that of *P. megalonyx*, while the male is decidedly less intensely black than in that form and *P. oregonus*. Compared with a specimen from the vicinity of San Francisco, California, the adult males of this series agree quite nearly in size, and the extent of the white patches on the tail-feathers; but they differ in being dull-, instead of intense coal-black, in having the white streaks on the outer interscapulars very small, and in the much longer hind claw.

P. CONSOBRINUS.

Nat. Mus. Cat. No.	Original No.	Sex and age.	Wing.	Tail.	Bill.	Tarsus.	Middle toe.	Hind claw.
70028	5	♂ ad.	3.10	3.50	0.40	1.08	0.70	0.50
70029	5	♂ ad.	3.20	3.70	0.40	1.05	0.75	0.55
70030	5	♂ ad.	3.25	3.80	0.40	1.10	0.75	0.55
70031	5	♂ ad.	3.15	3.65	0.38	1.10	0.75	0.50
70032	5	♂ ad.	3.20	3.65	0.38	1.10	0.72	0.55
70033	16	♀ ad.	2.95	3.65	0.40	1.10	0.60	0.50
70034	16	♀ ad.	2.90	3.25	0.38	1.05	0.65	0.55
70035	16	♀ ad.	2.90	3.25	0.35	1.00	0.60	0.50
		♀ ad.	2.90	.....	0.35	1.00	0.65	0.50

P. OREGONUS.

No. Mus. R. R.	Sex and age.	Locality.	Date.	Wing.	Tail.	Bill.	Tarsus.	Middle toe.	Hind claw.
466	♂ ad.	San Francisco, Cal.....	.....	3.35	4.00	0.40	1.05	0.75	0.45

P. MEGALONYX.

465	♀ ad.	Fort Tejon, Cal.....	Nov. 13, ——	3.30	4.10	0.35	1.10	0.70	0.50

P. CARMANI.

2169	♀ ad.	.....	.....	2.85	3.30	0.35	1.05	0.65	0.40

Collector's notes.

Iris orange. Not abundant; found chiefly in the woods of the central portion of the island. When startled, they emit a short whistle of three or four syllables. They frequent brushwood, fallen logs, fences, etc., rather than trees. Insects as well as seeds are generally found in their stomachs. Their method of scratching among fallen leaves is curious: they make a jump forward, at the same instant strike back with both feet.

FAM. PICIDÆ.

7. COLAPTES MEXICANUS RUFIPILEUS, *nobis.*

CH.—*Adult female:*—Above grayish-brown, becoming bright tawny on the forehead, lores, and maxillary region; dorsal region and wings, except primaries and primary-coverts, marked with transverse bars of black; rump and upper tail-coverts pinkish-white, the latter marked with transverse, somewhat oval, spots of black. Tail black, the basal two-thirds of the under surface vermilion-red; shafts of the primaries deep vermilion, their inner webs light vermilion basally, dull grayish-brown, glossed with red, toward ends. Head and throat, except as described, dull ash-gray; jugulum with a transverse crescent of black, bounded anteriorly by pale brownish-pink; rest of lower parts light brownish-pink, thickly marked with circular and cordate spots of black. Wing, 5.90–6.25; tail, 4.75–5.30; bill, from nostril, 1.35–1.60.

Remarks.—In the closed tail, only about half an inch of red is exposed on the under surface beyond the lower coverts, the remaining 2.50 being uniform black. The main differences from the continental form consist in the longer bill, more pinkish rump, and bright tawny forehead. In the latter feature, the resemblance is closer to *C. chrysoides*, the crown and nape having about the same gradation from bright cinnamon-tawny anteriorly to dull grayish-cinnamon posteriorly. It differs from true *C. mexicanus* as follows:—

C. MEXICANUS RUFIPILEUS.—Wing, 5.90–6.25; tail, 4.75–5.30; bill, 1.35–1.60. Black of the tail occupying the terminal 2.40–2.50 inches; crown cinnamon-color, becoming bright tawny anteriorly; rump pale pink or pinkish white. *Hab.*—Guadeloupe.

C. MEXICANUS MEXICANUS.—Wing, 6.65–6.95; tail, 5.50–5.90; bill, 1.15–1.25. Black of the tail occupying the terminal 1.90–2.00 inches; crown brownish-gray, becoming browner anteriorly; rump pure white. *Hab.*—Western Province of North America (continental).

C. RUFIPILEUS.

Nat. Mus. No.	Original No.	Sex and age.	Wing.	Tail.	Bill.*
70000	3	♀ ad.	6.25	5.30	1.40
70001	3	♀ ad.	5.90	4.75	1.60
70002	3	♀ ad.	6.25	5.25	1.35

* From nostril.

C. MEXICANUS.

Mus. R. R.	Sex and age.	Locality.	Wing.	Tail.	Bill.
2916	♂ ad.	Washington Territory	6.95	5.90	1.25
2917	♀ ad.	do	6.65	5.50	1.15

Collector's notes.

Rare, and apparently only found in the pine-woods of the north end of the island.

FAM. STRIGIDÆ.

Two kinds of owls were seen on the island, but as no specimens of either were obtained it is quite impossible to indicate the species.

FAM. FALCONIDÆ.

8. POLYBORUS LUTOSUS (*Ridgw.*)

Polyborus lutosus RIDGWAY, Bull. U. S. Geol. & Geog. Survey of the Territories (F. V. Hayden), No. 6, second series, p. 459.

SP. CH.—Wing, 15.00–16.40; tail, 10.50–11.65; culmen, 1.25–1.35; tarsus, 3.50–3.75; middle toe, 1.80–2.10. *Adult:*—Pileum, lesser wing-coverts, secondaries, primary-coverts, alula, terminal portion of primaries, entire lining of the wing (including axillars), and terminal band on the tail (1.00–1.60 wide) blackish-brown, sometimes almost black; auriculars, cheeks, and throat dirty whitish, or light isabella-color. Rest of the plumage marked with transverse bars of brownish-black, or dark brown, and brownish white, or light isabella-color, the bars most regular on the lower surface (and often the upper tail-coverts), where they extend uninterruptedly from the foreneck to the crissum, the bars of the two colors being about equal in width, the dark ones fainter on the crissum, narrower and more distant on the foreneck; on the middle and greater wing-coverts they are similar to those on the abdomen; on the interscapulars the dark ones are much wider than the light ones, and nearly black; on the scapulars dark brown prevails, the lighter bars being almost obliterated. The basal half or more of the outer five or six primaries are isabella-white, transversely mottled, or raggedly barred, with grayish and dusky, the shafts clear yellowish-white. Tail, except dusky terminal band, marked with ragged transverse bars of brownish-gray and isabella-white, of equal widths, the bars of the two colors separated by a narrower zigzag bar of dusky. *Immature.*—Remiges and rectrices the same as in the adult, but the terminal band of the tail narrower and less sharply defined; pileum and lesser wing-coverts dark brown, the feathers with lighter brown edges (these sometimes worn off); back and scapulars dull grayish-brown, the latter plain, the former usually slightly variegated with lighter borders and tips to the feathers. Lower parts light grayish-brown, with longitudinal dashes of dirty whitish; upper tail-coverts dull grayish-brown, tipped with dirty whitish, and sometimes barred with the same, the feathers with darker shaft-streaks; lower tail-coverts very indistinctly marked in much the same manner. Auriculars, cheeks, and throat plain dirty white, as in the adult. *Pullus.*—General color light isabella-color, or brownish-white, with an umber-brown patch over the scapula, connected with one over the radius and ulna; pileum uniform umber-brown.

Remarks.—In the adult plumage, all the contour-feathers have distinctly black shafts, especially on the lower surface and upper tail-coverts; on the tibiæ and anal-region, the dark bars are smaller and more faint than elsewhere, and incline to a sagittate form; the feathers of the lining of the wing are sometimes narrowly tipped with light isabella-color, or tawny-brown, and the transverse bars are faintest and

most confused on the upper portion of the rump. In both adult and immature stages there is considerable variation, but all within the limits of the above diagnosis.

List of specimens.

Nat. Mus. No.	Coll. No.	Sex and age.	Date. (1875.)	Wing.	Tail.	Culmen.	Tarsus.	Middle toe.	Remarks.
69980	22	—juv.	.....	15.75	11.25	1.30	3.70	1.95	No. 66989, "Eye brown; legs and cere dead white, with a bluish tinge." No. 66990, "Legs light yellow; cere, etc., salmon-color."
69981	30	♀juv.	.....	15.50	11.25	1.30	3.50	1.90	
69982	31	— ad.	.....	16.00	10.80	1.35	3.70	2.00	
69983	32	— ad.	.....	15.50	10.65	.....	3.60	1.90	
69984	18	♀ ad.	May 10	16.40	11.65	1.30	3.65	2.10	
69985	25	—juv.	.....	16.10	11.25	1.25	3.65	2.00	
69986	17	—juv.	.....	15.80	10.75	1.25	3.60	2.05	
69987	23	— ad.	May 10	15.75	11.00	1.30	3.50	1.90	
69988	27	—juv.	.....	15.50	10.50	1.30	3.65	1.90	
69989	21	♂juv.	.....	15.00	10.50	1.25	3.55	1.80	
69990	20	♂juv.	.....	15.50	11.00	1.30	3.65	2.05	
69991	33	♂juv.	.....	15.50	10.60	1.30	3.60	1.95	
69992	26	— ad.	.....	15.80	11.00	1.30	3.50	1.95	
69993	24	♀ ad.	.....	15.50	10.60	1.25	3.60	2.00	
69994	29	—juv.	.....	15.50	11.00	1.30	3.75	1.90	
69995	19	— ad.	.....	15.75	11.00	1.25	3.60	1.90	
69996	48	— pull.	May 10	.....	.....	.....	.....	.....	
69997	48	— pull.	May 10	.....	.....	.....	.....	.....	
69998	48	— pull.	May 10	.....	.....	.....	.....	.....	
69999	34	— pull.	Apr. 11	.....	.....	.....	.....	.....	

This species resembles the *P. tharus* much more than it does the *P. cheriway*, but it is nevertheless so very distinct as not to need actual comparison. The tail is entirely different in its markings, the darker bars being much wider than the light ones (twice as wide) on the middle feathers, while each is bordered with a narrower zigzag bar of dusky; the lighter markings are moreover light isabella-color, instead of white, as in *P. tharus*, in which white forms the ground-color, over which cross very narrow bars of grayish-brown. The rump and upper tail-coverts are very indistinctly barred, brown being the prevailing color, while in *P. tharus* this region is white, narrowly barred with grayish-brown. The ground-color of the lower parts is light isabella-color, with imperfect, more or less sagittate, bars of brown, whereas in *P. tharus* these portions are black, crossed with narrow, regularly transverse, bars of brownish-white. The throat is light isabella-color, while in *P. tharus* it is white. Other differences might be mentioned, but they are too numerous. Briefly, the more conspicuous differences between the three species may be contrasted as follows:—

P. LUTOSUS.—*Scapulars plain dusky brown. Tibiæ and flanks light isabella-color*, barred with dark brown. Wing-coverts (middle and greater) marked with wide bars of brown and pale isabella-color, of equal width. Tail-coverts and rump with broad bars of light isabella-color and grayish-brown. *Tail with broad bars of pale isabella-color and grayish-brown, separated by zigzag lines of dusky. Abdomen isabella-color*, with small sagittate bars of dark brown.

P. THARUS.—Scapulars barred grayish-white and black. *Tibiæ and flanks nearly uniform blackish-brown.* Wing-coverts brown, narrowly barred with whitish. *Tail-coverts and rump white, with narrow bars of grayish-brown. Tail white, with narrow bars of brownish-gray. Abdomen blackish-brown*, with transverse bars of whitish.

P. CHERIWAY.—Scapulars plain brownish-black. Tibiæ and flanks plain black. Wing-coverts plain blackish. *Tail-coverts and rump plain white*, without bars. Tail as in *P. tharus*. *Abdomen plain black.**

* The characters in *italics* are those common to the adult and young plumage.

Four young birds taken from the same nest differ remarkably in size and general development, the smallest being apparently just hatched, while the largest is nearly one-third grown, with well-developed feathers in the wings and tail. The other specimens were intermediate. The collector, remarking upon this disparity, believes that they were hatched successively, the female having commenced incubation as soon as the first egg was laid. This is after the manner of the American Cuckoos (*Coccyzus*); but a similar case among the raptorial birds is so exceptional that the present instance is very remarkable.

The local name of this bird is given by the collector as "Calalie", by which is probably meant *Queleli*, a name by which several vultures, besides hawks of the group to which the present species belongs, are known in portions of Mexico and California. It is stated to be the most conspicuous, and in one sense most notable, bird of the island, from its abundance, its size, and the damage it does to the flocks of goats. A good idea of its daring and its ferocity may be gathered from the collector's memoranda :—

Collector's notes.

"The 'Calalie' is abundant on every part of the island; and no bird could be a more persistent or more cruel enemy of the poultry and domestic animals. It is continually on the watch, and in spite of every precaution often snatches its prey from the very doors of the houses. The destruction of the wild goats is not so great, as these animals are better able to protect themselves than the tame ones. No sooner is one kid born—while the mother is in labor with the second—than the birds pounce upon it; and should the old one be able to interfere, she is also assaulted. No kid is safe from their attacks. Should a number be together, the birds unite their forces, and, with great noise and flapping of their wings, generally manage to separate the weakest one and dispatch it. They sometimes fasten upon the tongue when the poor creature opens its mouth to bleat, and have been known to tear it out, leaving the animal to perish, if not otherwise destroyed. Sometimes the anus is the point of first attack. The birds are cruel in the extreme, and the torture sometimes inflicted upon the defenseless animals is painful to witness. They occasionally, when pressed by hunger, attack full-grown goats; numbers harass it together from all sides at once, and soon put it to death. A 'burro' (jackass) which had accidentally become wedged among some rocks, was once furiously attacked and lost its eyes before assistance reached it. Even when food is plenty, they often attack living animals instead of contenting themselves with the carcasses of those already dead, seeming to delight in killing. Should one of their own number be disabled or wounded, it is instantly dispatched by the rest. Hundreds of the birds have been destroyed by the inhabitants, both with poison and fire-arms, without noticeable diminution of their numbers. They are said to lay three eggs, speckled like a gull's. When surprised or wounded, they emit a loud, harsh scream, something like that of the Bald Eagle. In fighting among themselves, they make a curious gabbling noise; and under any special excitement the same sounds are given forth, with an odd motion of the head, the neck being first stretched out to its full length and then bent backward till the head almost rests upon the back. The same odd motions are made and similar noises emitted when the birds are about to make an attack upon a kid.

"Besides the principal sources of food-supply already indicated, the birds have other means of subsistence. They eat small birds, mice,

shell-fish, worms, and insects. To procure the latter, they resort to plowed fields, where they scratch the ground almost like domestic fowls.

"They are tough, strong birds, requiring a heavy charge of shot to bring them down."

COLYMBIDÆ.

9. COLYMBUS ARCTICUS PACIFICUS (*Lawr.*)

One specimen, in adult breeding-plumage, washed ashore, dead.

Nat. Mus. No.	Original No.	Sex and age.	Date.
70003	47	♂ ad.	May 20, —

PLATE 30.

(*Herpetotheres cachinnans.*)

Fig. 1. Head, showing outline of bill, form of crest, and other external features.
2. One-half of the skull seen from above, showing superciliary process of the lachrymal.
3 Supramaxillary and nasals, showing nostril.
4. Mandible.
5. Coracoid apparatus. *a* = scapular process of the coracoid.
[All natural size.]

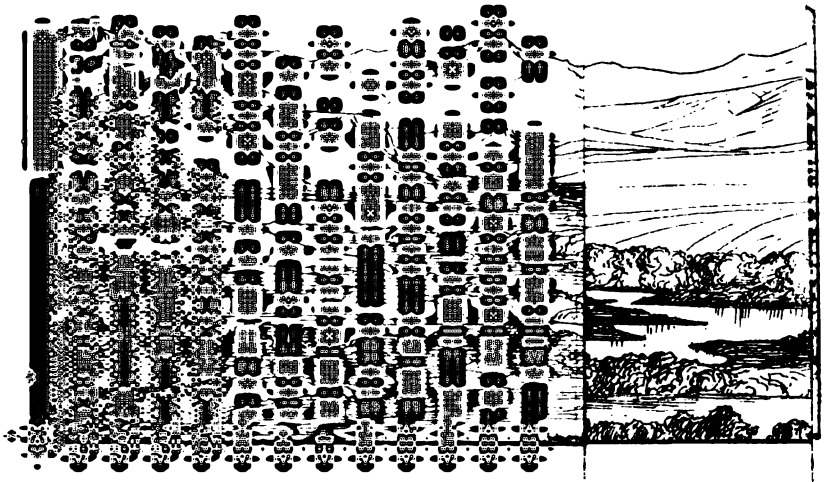
4.

PLATE 31.

(*Herpetotheres cachinnans.*).

Fig. 1. Sternum, under view.
2. Foot.
[Natural size.]

1.
2



uri, Looking W

. c, Madison. d,

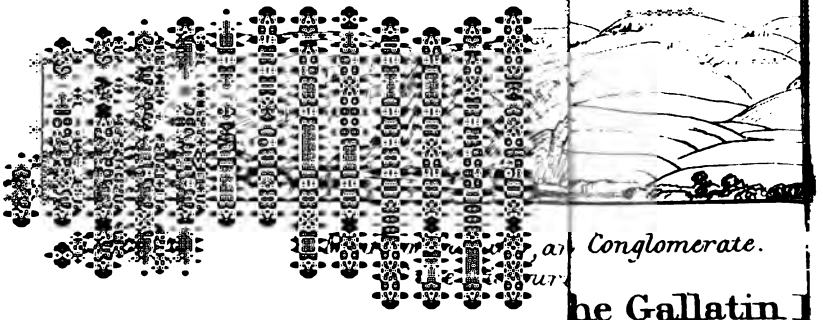


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Plate I.

OTES DESCRIPTIVE OF SOME GEOLOGICAL SECTIONS OF THE COUNTRY ABOUT THE HEADWATERS OF THE MISSOURI AND YELLOWSTONE RIVERS.

By F. V. Hayden.

It is not intended that these notes shall embrace a complete account the geology of Montana. They are simply designed to render the autiful pictorial sections which accompany them more intelligible to e general reader. That these pictorial sections may reach the public ner, an edition of them is issued in this form. All the sections in this per represent the scenery along the immediate valleys of the Lower llatin and Madison Rivers, with the exception of two, which are fine astrations of different portions of the Yellowstone Valley.

It is hardly possible for the pencil of the artist to delineate more aphically or minutely the scenery of this interesting country than ese sections do. For the geologist very little descriptive text is eded, and for the details of the geology he is referred to the Annual eports of the Survey for 1871 and 1872.

Should the Survey continue its operations from year to year by suitble grants of money from Congress, all the region, including the Yellowone National Park, will be re examined systematically and in detail; hat we have done up to this time must, therefore, be little more than eliminary to the more thorough work that must come hereafter.

I have always regarded the junction of the three forks of the Misuri—the Gallatin, Madison, and Jefferson—as one of the most interting geographical points along the Missouri River. Here, within a ort distance of each other—a few hundred yards apart—these three eat streams unite in one, forming the Missouri River. This junction most admirably shown in Plate I, upper sketch, which is really a panamic view of the valley with the surrounding hills. The view is taken oking west from Gallatin Bluffs. At the right hand, at *a*, the three vers have united into one channel, just at the upper end of a cañon, or rge through Carboniferous limestones.

In the bottom, and especially on the point between the Madison and fferson Rivers, are remnants of Carboniferous limestone, with a few aracteristic fossils. These remnants are found at different points in e immediate valleys of these streams, showing most clearly that the oad space now occupied with the lake-deposits, between the Jefferson d Gallatin Rivers, was originally worn out of the sedimentary beds of s locality. In other words, we obtain in this way a glimpse of the mendous magnitude of the erosive action in past times in this reon.

In the background are weathered hills, rising from 600 to 1,200 feet ve the valley, underlaid, for the most part, with the limestones of rboniferous age, inclining toward the north or northeast. Other forations come in, farther and farther in the background, as the Juras-

sic, Cretaceous, and even remnants of the Lignitic group, which, by the yielding nature of the materials composing these rocks, have given rather a smooth, rounded outline to the surface over an extended area.

This sketch will serve to convey to the reader a conception of the peculiar area which may be noted on the map as included between the Gallatin and Jefferson Rivers, above their junction.

Nearly all the sections described in this paper represent portions of the surface included within this space.

Within this area also is inclosed one of the most complicated and instructive of the great mountain anticlinals.

It is only by taking this position, which seems to be borne out by the facts, that we can unravel the complicated topography of this district. Plate III represents portions of a continuous section, the left-hand end of No. 2 joining on to the right-hand end of the upper section of No. 1, the whole forming the high wall-like range on the east side of the Gallatin Valley, extending from a point below Flathead Pass to the Bridger Cañon to the northward. There is then a short distance in which no rocks older than the Lignitic group are exposed. The older groups, however, re-appear on the divide between the Gallatin and Yellowstone Valley, crossing the Yellowstone and thus form the Lower Cañon.

In Plate VII, lower section, Second Valley of the Yellowstone, looking west from Mount Delano, at the right hand, we see the Carboniferous limestones inclining at an angle of 30° to 50° to the northwest. The Yellowstone River has cut its channel through this high ridge of limestone at right angles.

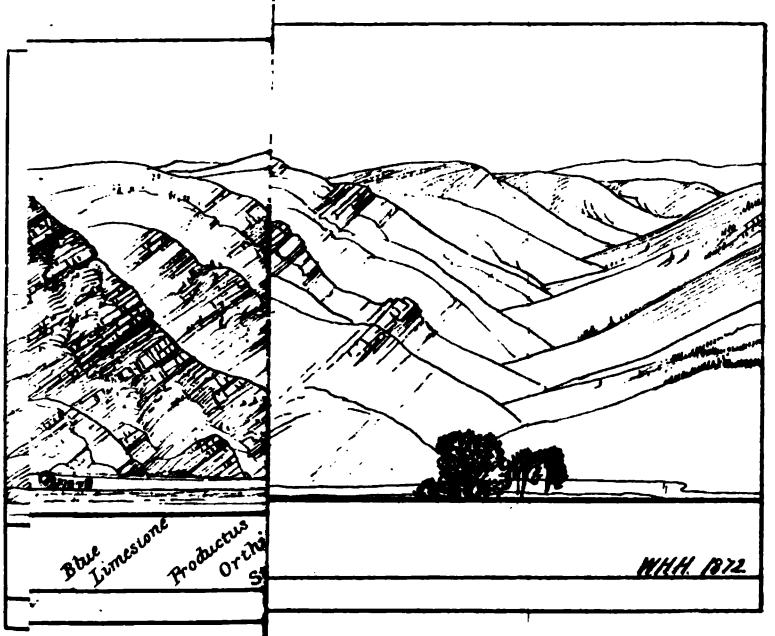
We have here, then, attempted to describe briefly the east or northeast portion of this great anticlinal, which, in future surveys, will be extended far to the northeast, beyond the limits of our geological map.

The structure of this first portion of the anticlinal is well shown in section 7, through Flathead Pass, on page 82 of Annual Report for 1872.

In the section, we observe that the Silurian strata, which are shown on the west side of the ridge, dip past a vertical, while the Carboniferous limestones, which form the crest, are vertical or nearly so, while the Jurassic, Cretaceous, and Lignitic beds incline at various angles to the northeast toward the valley of Shield's River.

It is probable that the corresponding opposite portion of this great anticlinal extends along the east side of the Jefferson Valley, rising like a slanting wall 2,000 feet above the plains below. It crosses the Jefferson near the entrance of the North and South Bowlder Creeks, and through this great ridge the river has worn a vast, deep, narrow gorge called the Cañon of the Jefferson. Here the river, for a distance of five miles, flows through nearly vertical walls of limestone, rising on either side from 700 to 1,200 feet. The general dip is apparently toward the west, or perhaps southwest. A very high ridge extends nearly north and south between the Jefferson and the South Bowlder Creeks. This ridge is cut through by the Stinkingwater, a branch of the Jefferson, thus forming a broad, valley-like opening, through which the road passes from the Jefferson Valley to Virginia City. On the west side of Stinkingwater Creek, the high limestone ridge continues westward to the sources of the creek, to Red Rock Creek and beyond.

It is probable that the axis of the great anticlinal lies for the most part between the Madison and the Jefferson, forming the granite belt from Sterling to Summit at the head of Alder Gulch. The granitic axis also includes a portion of the country east of the Madison. The general trend of the axis is about northwest and southeast. We may



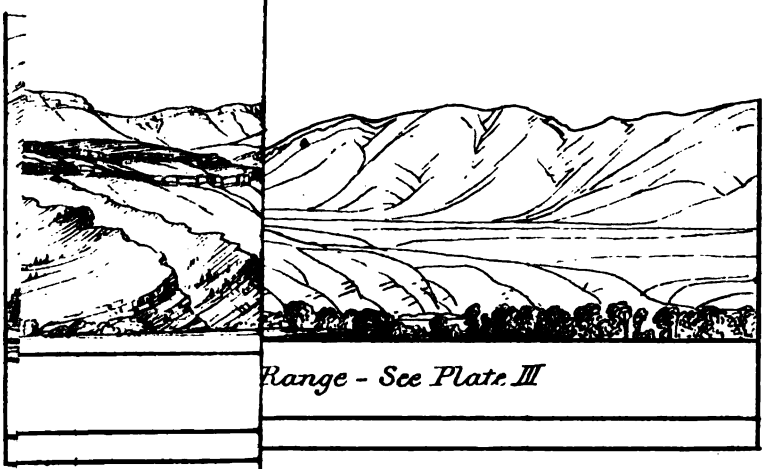


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Plate II.

therefore conclude the area embraced in the drainage of the three great branches of the Missouri River—the Gallatin, Madison, and Jefferson Rivers—is broken up by a large mountain anticlinal. Its entire extent is not yet known. It probably covers a somewhat larger area, reaching over into the Yellowstone drainage, and extending north below the three forks.

The structure of this area, although apparently so simple, is very complex, from the introduction of a different force, which seems to have acted synchronously with the one that lifted the granitic nucleus, and which may have been produced by it. This is the volcanic force which has acted most powerfully all over the region. It is by the effusion of the igneous rocks that the sedimentary beds are often thrown into the most chaotic confusion, so that the regular anticlinal ridges are, in many places, entirely broken up and lost. Sometimes we find these beds in patches on the summits of the highest mountain-ranges, and again in the lowest valleys. Faulting on a large scale has been everywhere produced. Over large areas, also, the igneous rocks have been poured out, thus concealing and protecting from erosion the sedimentary beds. On the divide between the Yellowstone Valley and the source of the Gallatin, the trachyte rocks cover all the sedimentary beds, even up to the Lignitic inclusive; and here and there, where the mountain-streams have cut deep gorges into the divide, the Silurian, Carboniferous, Triassic, Jurassic, Cretaceous, and Lignitic can be seen in their order of position. Not unfrequently all the older beds, with the exception of the Carboniferous, had been worn away prior to the effusion of the trachyte, and the beds of limestone crop out along the margins of the mountains and cañons from beneath their igneous covering.

There is a striking example of this along the East Fork of the Yellowstone River, as is shown in Plate X in the "View looking up Soda Butte Creek from Camp on the East Fork of the Yellowstone." We have here 2,500 to 3,000 feet of volcanic breccia and tuffs, mingled here and there with trachyte. This is cut in every direction by little branches into the most picturesque gorges, with very vertical walls on either side, from 1,500 to 2,500 feet in height, apparently stratified and weathered so as to present a peculiar but imperfect columnar appearance. The surface-weathering is in the form of immense castles, battlements, steeples, and towers. Index and Pilot Peaks, in the illustrations in the Annual Report for 1872, page 47, convey a faint idea of the wilderness of unique forms which are presented to the eye over this great volcanic area.

This volcanic material was laid on an irregular surface of limestone mostly of Carboniferous age. Sometimes the red-beds are seen just beneath the breccia beds. From the entrance of Soda Butte Creek into the East Fork of the Yellowstone to its source, a distance of ten miles or more, the limestones crop out on either side of the gorge. Sometimes only ten or fifteen feet are exposed, then again several hundred feet in thickness are seen, with only a thin bed of breccia on the summit.

Over a considerable portion of the Yellowstone National Park, the Lignitic beds crop out here and there, from beneath the igneous covering, in a baked or partially metamorphosed condition, containing fine specimens of plants of various species.

There are also many examples of quite modern volcanic action, in which the basalts have been poured over the modern Pleiocene or lake deposits, and even the local drift.

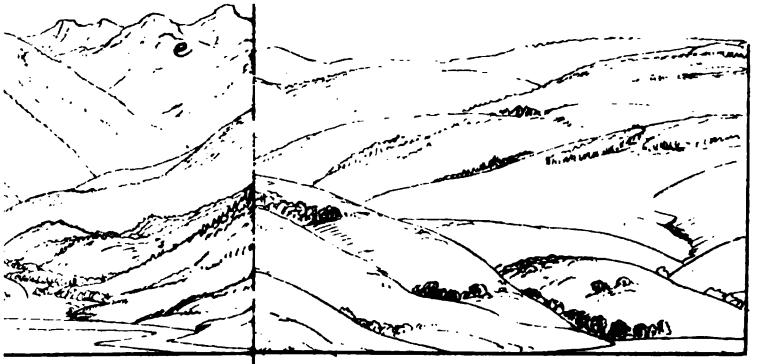
The evidence seems to be clear that the volcanic effusion commenced far back in the past, at the commencement of the elevation of the mount-

ain-ranges, and continued periodically, even up to the present tim nearly so.

The drainage was undoubtedly marked out at an early period. Yellowstone and Madison Rivers rise in the main divide of the R Mountains, while crowded in between them, as it were, is the Gal River, which fails to reach the divide with any of its sources. The latin flows through a narrow channel, or cañon, most of the way fro source to its entrance into the Gallatin Valley, a distance of about miles. The drainage seems to have originated in a sort of depressic sag, in the sedimentary crust; for the gorge has there worn through t rocks for nearly the entire distance, and the inclination of the strat either side is toward the cañon. Nothing seems to have even defle the river from its course, but it has worn its narrow way directly thr highest mountains, as is shown in the six consecutive sections in P IV, V, and VI. The erosion of the channel, or cañon, must have menced with the elevation of the crust, and continued on, keeping with the elevating forces. Obstructions from time to time have occu which produced in part the numerous lake-basins which we find a present time in the valleys of all the mountain-streams.

In the previous reports of the Survey, I have treated much in d the curious old lake-basins that are found so extensively all ove West. There is a certain group of them that might be classed unde head. They have been called Modern Lake-deposits, Lacustrine Their age is probably Pleiocene, but they undoubtedly overlap wh have usually understood as the Post-Pleiocene period, reaching al up to the present time. There is, however, a subsequent de which, on the geological map, we have regarded as fluviatile, whic account of its extent must be noted. This oftentimes conceals the custrine deposits. The fluviatile deposits are entirely local, and con to the drainage-areas in which they are found. They assume im ance from the fact that they date back to a period when there much more water in the streams than at the present time, and in c quence the results of the aqueous forces were much more ma than they are now. There is another important feature, that al placer-mining is carried on in these deposits. They undoubtedly back so as to include what is usually understood as the Glacial p in the West. In the various mining-gulches in Montana, these fluv deposits are oftentimes of great thickness, made up mostly of much- bowlders. In Alder Gulch, for example, which is the valley of a s branch of the Stinkingwater which flows into the Jefferson, $30,00 of gold have been taken out. Near the source of the gulch, the bow are of great size, but growing gradually smaller toward its junction the main branch until the fluviatile deposits are made up of rather sediments, with perhaps layers of gravel. The vast extent of this de conveys a dim conception of the tremendous erosion the surface has u gone in past times. There is comparatively little snow in these regio the present time, and the streams are never so high that they pro any very marked effect on these deposits, and scarcely nothing s as erosion is concerned, so that we are led easily to the conclusion there was a period when the aqueous and most probably the ac glacial forces acted with great power.

As we have previously stated, the Lacustrine deposits belon part at least, to a prior period. Perhaps the most conspicuous exa of one of these lakes is found at and near the junction of the three of the Missouri. The junction of the three branches seems to b north end of this basin, though immediately below the junction t



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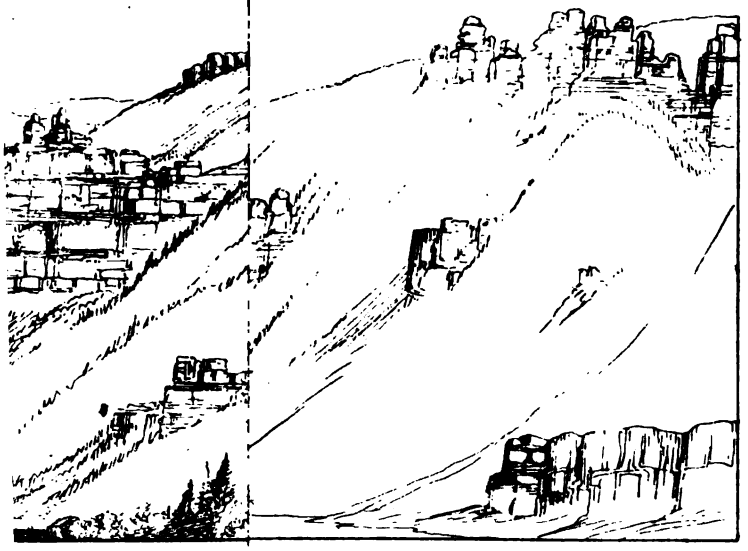

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and Niobrara Rivers, are singularly alike, indicating their derivation fro the same source. The metamorphic rocks all over the West are com posed mostly of quartz and feldspar, the former predominating. It i from the decomposition of these rocks that most of the Lacustrine sedi ments are derived. Judging from the character of the sediments, ther were no violent currents in the channels of the streams in Lacustrin times, unless near their source. The sediments do not seem to diffe essentially in fineness where they lap over the flanks of the granit hills at the upper side of the basin.

The filling-up of the basin also caused the channel above to be full, s that the fine matter would be distributed over the basin very equably and settle quietly at the bottom, as in any of our small fresh-water lake of the present time. The thickness of the deposits in this basin may b estimated at from 1,200 to 1,500 feet. The height of the divide betwee Madison and Gallatin Rivers ranges from 600 to 1,000 feet above th beds of those streams, so that it is probable that the estimate of th aggregate thickness as 1,500 feet is rather under than over the tru one.

The writer was unable to find any of the vertebrate remains in thi basin that have usually been obtained from this formation in man other places. Many persons living in the country informed me the had seen remains of turtles, fragments of skulls, and bones of othe animals in various places, but the time at my disposal did not perm me to make a careful search. In the side gorges, or gullies, of the Mad son, we found most beautiful specimens of silicified wood in great qua tities, some of which might be said to be opalized.

In the valley of the Jefferson, near its source, there is one of thes small expansions of the valley, in which there is a considerable thicl ness of the Lacustrine sediments. In 1871, I found there a species *Helix*, and the jaws of a vertebrate animal of the genus *Anchitheriu*

In the American Journal of Science for February, 1876, Messrs. Gri nell and Dana discovered a lake-basin near Camp Baker on Dry Creel which is evidently one of great interest. In this basin they seem have found a variety of vertebrate remains, representing two epoch Miocene and Pleiocene. I am not aware that the lower beds of tl White River group had been previously observed in Montana. It quite possible, as the gentlemen suggest, that the Pleiocene lake Deep River was connected with those near Fort Ellis and the Thr Forks. We may, with perfect confidence, connect them all, for they ca be traced with very short interruptions from the sources of the Madis and Yellowstone Rivers and their branches to the points where tl rivers leave the mountain-districts for the plains. It may be r marked here that these peculiar Lacustrine deposits are found for tl most part only in the mountainous portions; that in the plains, if th ever occur at all, they are of older date. In the valley of the Sweetwat River there are isolated patches of the Pleiocene marls distributed ov the Miocene deposits, very similar to those on Deep Creek; but there a here low granite ridges on either side, showing that the foundation-ro on which the modern Tertiary deposits were laid down in that regi is granite or gneiss. These same modern Lacustrine deposits occur the North and Middle Parks, Colorado.

The lower section of Plate VII, "The Second Valley of the Yello stone," is an illustration of one of the oval Lacustrine basins so co 'ong the rivers. It is about thirty miles long, and will avera e miles in width. The lake-sediments have been swept out to a great extent, but there are quite large remnants remai

ing, which show clearly that there was originally a considerable thickness of them. At the upper end, broad sheets of basalt have flowed over it, protecting the lake-deposits from erosion. This basin has been entirely scooped out of the mountains, which originally extended across much as we now see them on either side. All over the valleys are remnants of the various rocks, changed and unchanged, just rising above the surface. At the right are seen a group of Carboniferous limestones, which extend directly across the Yellowstone River. The channel which the river has worn through these rocks is called the Lower Cañon, or the Gate of the Mountains. The cañon is about three miles in length, leading into a comparatively small oval expansion, which was originally a lake, and thence into the plains. Inasmuch as all the sedimentary strata from the Lower Silurian to the Lignitic inclusive seem to have been alike involved in the movements of the crust that elevated them to their present position, we infer that these movements were a subsequent event. There is also evidence for the statement that the unchanged rock, prior to this time, extended uniformly over nearly or quite the entire area of Montana. There is no positive proof that the metamorphic rocks were anywhere exposed. The members of the survey searched in vain for any proof of unconformability of position in any of the unchanged strata. Therefore, the vast erosion which has taken place in this region must have occurred during the crust-movements and subsequently. I have before stated that these lake-basins are largely due to erosion. We must conclude, therefore, that depressions were produced during the crust-movements, which received the drainage from the higher lands around, and that the waters thus accumulating gradually carved out these basins as we find them at the present time. These depressions may have been limited in area at first, and may or may not have been produced by the disturbance of the strata; but it is probable that in most cases it is due to the latter cause. We may state, however, in this connection, that the channels of any of the rivers of the West do not necessarily lie along any fissures, anticlinal or synclinal depressions; but the rivers seem to have, in the majority of cases, cut their way directly across the line of fracture, thus carving out deep gorges through the loftiest mountain-ranges. There are numerous examples where rivers seem to have avoided natural depressions, where it would appear that the waters must flow, and cut narrow channels through the hardest rocks. The Gallatin, as well as the Yellowstone, is a remarkable example of this statement. In their entire course, they run almost directly across the line of fracture of the mountain-ranges in the vicinity. The Yellowstone has worn out the enormous second canon with walls 1,000 to 1,500 feet from the granite nucleus. A little to the northwest, the Gallatin flows between walls of granite 2,000 feet high on either side. Still we must admit that in order to produce such results they must have had an original foothold, as it were, to commence their work. The evidence seems to be clear that, during the Tertiary period, and subsequently, the aqueous forces were much more powerful and widely extended than at the present time. All the water-courses and lake-basins, of the West indicate the existence then, of bodies of water compared with which our present rivers and lakes are but rivulets and ponds. We do not find the Miocene lake-deposits underlying the Pleiocene in the vicinity of the mountain-districts. They are found at a long distance from the principal centers of disturbance. We may suppose, therefore, that there were really three important periods which should be considered: First, when the channels of the rivers and the lake-basins were

worn out, the aqueous forces operating with great power, and transporting the sediments down into the Miocene lakes of the plains; second, when the waters set back up toward the sources of all the mountain-streams, producing that quiet condition in the lake-basins that enabled the finer sediments to settle upon the bottoms of the Pleiocene lakes, with the strata regular and horizontal as we find them at the present time; the third period may be regarded as the one when the local drift-deposits were made. This period was one in which the forces operating were those of water and ice, or what is understood as the Glacial era of the West. The channels of all the rivers were deepened, and the Lacustrine deposits were in part removed and carried down into the plains.

It was during this period that the terraces and fine sections were here formed, which are so admirably shown in Plates VIII and IX. The deposits of this third period are immense in many localities, concealing all the basis-rocks and giving the peculiar slopes to the base of the mountains as they graduate into the plains. In the mountain-valleys, as, for instance, in the oval lake-basins between the lower and second cañons of the Yellowstone, high bowlders of granite, 25 feet in diameter, have been brought down from the mountains and lodged on the surface of the terraces at different elevations above the present river-bed. The remnants of the layers or floor of basalt that, since the deposition of the Lacustrine sediments, have flowed over the valley, exhibit abundant proofs of glacial action in the very smooth crust, which even now is like enamel. On this basaltic floor, 50 to 100 feet above the bed of the Yellowstone River, many of these large bowlders now rest. Worn masses of smaller size are scattered thickly all over the surface. The greater portion of the local drift is composed of rounded bowlders, varying from a few inches to several feet in diameter, with a small proportion of sand and clay mingled with it. It is at the bottom of this deposit, near what is termed by the miners the bed-rock, that placer gold is found.

It is not pretended that the three periods named above can be defined by arbitrary lines by any proofs that have been left on the surface at the present time. The first period must have commenced either during or at the close of the Miocene era; and there is nothing that indicates any remarkable abrupt break in the sequence of events up to the present time. There was undoubtedly a constant variation in the intensity of the forces that were in operation during all these periods. During the Miocene and Pliocene periods, the animal remains which were preserved in the Lacustrine sediments indicate a comparatively mild climate. The cold period must have approachd gradually, reaching its greatest intensity, covering the mountains and filling the valleys with immense bodies of snow and ice, which slowly melted away, leaving the peculiar lake-basins at the sources of the mountain-streams and morainal deposits, as proofs of its former existence. It is probable, also, that it was during the decrease of temperature, while the waters were subsiding to their present condition, that the terraces were formed. It is not the purpose of this article to present anything like a complete view of the geology of Montana. It is intended simply to render more plain, if possible, the meaning of the beautiful pictorial sections which accompany it. As representations of the varied forms of the scenery in Montana, and, indeed, to a limited extent, in any other portion of the West, they are unsurpassed.

Some of the plates have already been described incidentally in these notes. Plates II and III are closely connected, though not intended to be absolutely parts of the same section. They were sketched from dif-

ferent points of view. The traveler, as he passes up the valley of the Gallatin, toward Bozeman, from the three forks, sees on his left hand, to the east, a high ridge, which rises up like a wall. The abrupt side is toward the valley, and an examination of its structure shows that it is a part of an anticlinal ridge. In Plate III, the right-hand end of Section 1 joins on to the left end of Section 2, and thus a connected view is obtained from below Flathead Pass at *a*, far south to Mount Ellis at *i*. North of Bridger Cañon, the strata are lifted up so that on the west side of the ridge, toward the Gallatin, the metamorphic rocks are exposed, while near the summit of the ridge the Silurian and Carboniferous strata are nearly vertical. From the summit of the ridge, the Triassic, Jurassic, Cretaceous, and Lignitic beds may be seen inclining at various angles, sloping off eastward toward Shield's River. The aggregate inclination of the strata in this ridge is about northeast. Proceeding northward, we find near Flathead Pass that the Silurian beds lie at the base of the ridge, and have been elevated so that they pitch past a vertical 30° to 50°, as is so well shown by the cross-section in the Annual Report of the Survey for 1872, page 84. These two pictorial sections serve to show the weathered forms of these ridges as seen at a distance, rather than the details of structure. The vertical furrows, with here and there a gorge cut directly through the ridge, forming what are called passes in this country, are well shown. From near Flathead Pass southward for several miles, the Silurian beds are lifted up in such a way that the entire series can readily be made out. From the right-hand end of the lower section in Plate II, the Silurian beds extend southward for about eight miles, then the Carboniferous strata overlie them, and are clearly exposed. This section extends along the east side of the Gallatin, and forms the bluffs which have been cut by its waters. The surface erosion of the beds is exhibited with remarkable clearness and perfection. In the Silurian and Carboniferous groups the characteristic fossils are very abundant. They are described in the Annual Report of the Survey for 1872. No Jurassic fossils were found in this immediate vicinity; but near the Yellowstone River, about thirty miles to the southwest, and at Spring Cañon to the southward in the same ridge, they are very abundant.

In Plate III, Section 2, the passes of Bridger Cañon and Spring Cañon are quite important from the fact that through one of them the Northern Pacific Railroad must run on its way from the Yellowstone Valley. These are rather narrow gorges cut by the little streams through the ridge, thus exposing an excellent though complicated section of the rocks. The foothills are composed of the Lacustrine deposits, which jut up against the sides of the mountains, sometimes nearly to their summits, apparently without any disturbance, unless it be of a local character. Mounts Delano and Cowen are on the east side of the Yellowstone Valley, their summits rising far above any point on the divide. Mount Ellis, 8,419 feet, is capped with Carboniferous and Jurassic rocks. Bridger Peak, 9,002 feet, is capped with Carboniferous limestones, and Liberty Peak is a portion of the same ridge.

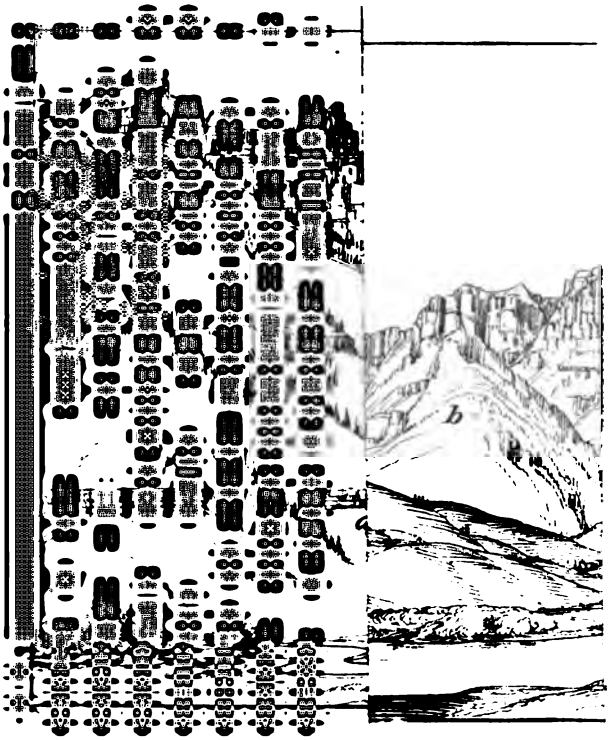
In Plates IV, V, and VI, and the upper portion of Plate VII, we have seven sections that are connected, and represent the east side of the Gallatin Cañon from its opening into the valley on the Lacustrine basin to a point nearly to the source of the river, a distance of about twenty-five miles. The four sections of Plates VIII and IX might have been connected also, as there is but a short interval between them. At the left hand of Section No. 1, we see the rounded foothills underlaid with gneissic rocks. The lower end of the cañon is at *a*. The direction is about

north and south, as will be seen by examination of the map. We will commence at the lower or north end of the cañon, and follow up through the several continuous sections and note the principal points of interest. At *c c*, the Carboniferous limestones appear with their peculiar type of weathering. The distant hills are underlaid by the granitic or metamorphic rocks. The limestones seem to have dropped down so that a fault of some importance exists. These Carboniferous limestones rest on Silurian beds. In Section No. 2, still farther up the cañon, we find the Silurian arenaceous limestones forming a rugged escarpment at the base, while on the rather rounded hills the Carboniferous limestones crop out. These hills rise about 1,000 feet above the bed of the river. We thus see that the metamorphic rocks, the Carboniferous and Silurian limestones, present three quite distinct types or forms of erosion, thus giving considerable variety to the scenery.

In Section No. 3, Plate V, the Silurian beds overlaid with Carboniferous limestones continue and pass over the summits of the hills, while from beneath them rise up the reddish feldspathic quartzites, which have weathered into peculiar sharp pinnacles. The river runs for about three miles through a narrow gorge, with vertical walls on either side rising up a thousand feet or more, beset with these sharp angular pinnacles. Above this point, the surface features are softened down, the rocks partially covered with earth, but cropping out in numerous places.

On looking at the geological map of Montana, &c., prepared from the results of the Survey in 1872, it will be seen that there is a small stream flowing into the West Gallatin on the west side, one branch of which rises in Lone Mountain, and the other branch in the Sphynx. Near the mouth of this stream, a high ridge of limestone crosses the Gallatin with a trend about northwest and southeast. On the east side of the Gallatin, the sharp ridges rise up to a height of 1,500 to 2,000 feet, with an inclination 50° southwest. Section No. 5, Plate VI, shows this ridge as it appears on the east side of the river, with the somewhat rounded granitic hills below, on which the limestones lean. The river has cut its channel directly through this ridge, and on the bottom, the worn edges of the upturned shales may be traced across the channel with perfect distinctness. In the section we see the Carboniferous limestones at *b* underlaid with Silurian rocks, resting directly on the granites; and lying against the Carboniferous beds are the Jurassic at *c c*, and at *d* patches of Cretaceous, which seem to have dropped down, as it were, in a sort of Jurassic synclinal.

The Silurian and Carboniferous, with a portion of the Jurassic group, appear to have been lifted up by a vertical force that broke the beds as if they were layers of lumber. In the depression which seems to have been produced by this movement, the Jurassic and Cretaceous beds are seen; but at a distance of about five miles, where, as shown in section No. 6, the Carboniferous limestones rise from beneath the Jurassic in a nearly horizontal position, it would appear that the elevation of the metamorphic rocks, pushing off, as it were, from the sides the sedimentary beds, produced a depression which formed an excellent reservoir for the drainage of the higher lands around, thus giving origin to a stream of water on both sides of the Gallatin. In the background in section 5, we see the group of volcanic peaks which form the divide between the Gallatin and the Yellowstone Rivers. In section 6, the rounded grassy character of the summits of the hills shows the more yielding nature of the Jurassic beds. It is not certain that the true red beds occur in this immediate vicinity. In section 7, we find another dropping-down or faulting of the strata. At *b* the Carboniferous limestones are



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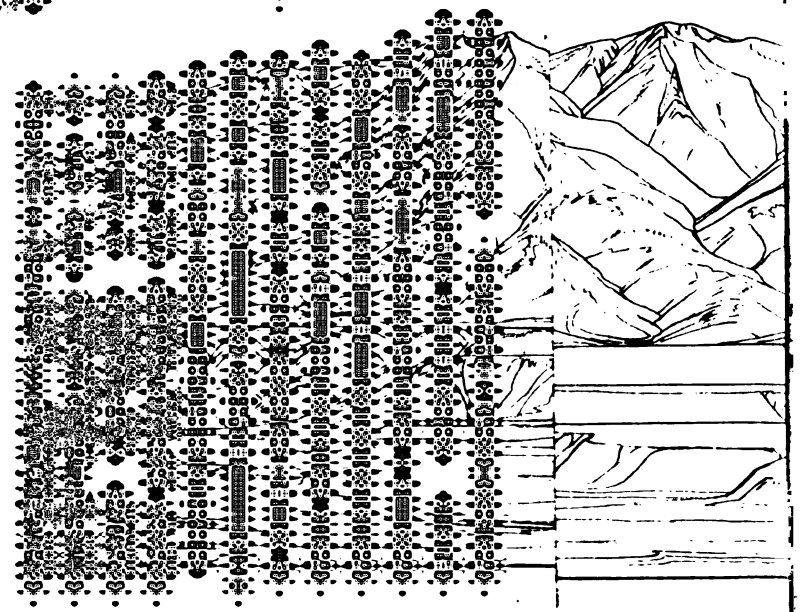

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nearly horizontal, while at *c c* the Jurassic beds present a reversed dip, forming a kind of synclinal valley. At *d d* are caps of volcanic material by the eruption of which these remarkable dislocations of the beds may have been produced. There is here an open valley for a short distance where the Gallatin again flows between high vertical walls of Carboniferous limestones with a dip of not more than 1° to 3°. These limestones are weathered into remarkably picturesque forms, castles with pinnacles, turrets, &c. Great quantities of fossils were found here which fixed the age of the rocks beyond any doubt. Plate X is composed of two isolated but very characteristic views of the scenery of this portion of Montana. The upper sketch represents with remarkable perfection the forms produced by erosion of the immense volcanic breccia beds about the sources of the Yellowstone. The sketch was taken from a point looking up Soda Butte Creek, a branch of the East Fork of the Yellowstone.

This small stream may be followed to its source, near the head of Clark's Fork, between nearly vertical walls of volcanic breccia, stratified, 1,500 to 2,000 feet in height. From beneath these mountains of breccia, beds of Carboniferous limestones crop out here and there, sometimes only a few feet above the bed of the stream, again rising to a height of several hundred feet. The hundreds of high mountain-peaks, 10,000 to 12,000 feet elevation above sea-level, which form the divide between the Yellowstone River and the sources of Clark's Fork, Stinkingwater, and Grey Bull Rivers, are composed of volcanic breccia, underlaid with Carboniferous limestones.

This sketch may be said to represent a type of most remarkable scenery, which covers a large portion of the country about the sources of the Yellowstone and the western branches of the Big Horn. Similar forms have been carved out of the breccias and trachyte around the sources of the East Gallatin near Mount Blackmore, of which Palace Butte is an example. A more detailed description of the East Fork and Soda Butte Creeks can be found in the Annual Report of the Survey for 1872, chapter III, commencing on page 44.

The sketch of the terraces of the middle valley of the Madison may be found described in considerable detail in the same report on page [illegible]. A more connected view is here presented, with the high range of mountains which forms the high divide between the Madison and the West Gallatin Rivers. The middle valley is an expansion or basin about thirty miles in length, and with an average width of five miles. The lower thirty miles presents the most remarkable system of terraces I have ever seen in the West, and I regard them as one of the wonders of this wonder-land. This valley was once the bed of a lake, and the lacustrine deposits lap on to the base of the mountains at an elevation of about 400 or 500 feet above the bed of the river. The surface of the terraces is composed of superficial drift or the usual Quaternary deposits of this country. Underneath them, especially at the lower end of the basin, the Lacustrine deposits are seen.

From our study of the mountain-ranges in Montana, as well as in other portions of the West, it would appear that the outflow of the igneous rocks is synchronous with their elevations. This is especially the case with those ranges which have a granite nucleus.

The igneous rocks are of different ages. The evidence about the sources of the Missouri and the Yellowstone is that the igneous material was formed more or less through all the periods from the very commencement of the general elevation of the country, which culminated in our present mountains. It may not at all times have come to the

surface; but through the vast erosion which has taken place subsequently, the igneous rocks of different ages have been exposed to view.

Over a considerable portion of Montana, Northwestern Wyoming, and the greater part of Idaho, the igneous material, with the accompanying tuffs and breccias, conceal the sedimentary as well as the metamorphic rocks; and they are only exposed to view in the deep gorges of the streams which are produced by erosion. So uniform are these conditions, that one would suspect an intimate connection between the movements of the vast masses of metamorphic rocks which usually form the nuclei of our mountain-ranges and the production of the igneous matter. Is it probable that the movements are so deep-seated as to reach down to melted matter already in that state, and thus affording it access to the surface, or was there sufficient heat generated by the friction of vast masses of rocks upon each other to produce the igneous rocks, as well as the force which has ejected such a vast amount of tuffs and breccia, as we find about the sources of the Yellowstone?

I am not now prepared to discuss this subject, but will simply state that our observations all over the West tend to show a most intimate relation between the eruption of igneous rocks and the elevations of the regular mountain-ranges. Again, an interesting series of observations has been made by the Survey from its commencement, which has been published from time to time in the annual reports, in regard to the channels of our rivers. We find that the channels of our large rivers have not been determined by special lines of depression or fractures, and that there is no necessary connection between them.

It is not an uncommon occurrence to find the channel of a river passing directly through a mountain-range or a ridge, when by a slight flexure it could have occupied a special depression or valley. The West Gallatin River, as is shown in section No. 5, Plate VI, cuts a cañon 1,500 to 2,000 feet in depth, through Sedimentary and Archæan rocks, for several miles, when by an easy flexure, as the surface now appears, it might have occupied areas of special or natural depression.

Nearly every cañon through which any of the rivers or smaller streams of Montana pass, and they are very numerous, present the same peculiarities. The Jefferson Fork presents striking examples of this kind, while the Missouri River below the junction of the three forks, the numerous gorges or cañons are plain illustrations of this statement. We must conclude that since the channels of these streams were marked out, the mountains have been elevated at least the amount of the present height of their summits above the beds of the streams; that the surface at that time was more favorable for the concentration of the drainage-waters along the line of the present cañon, as it passed over what are now the very summits of the mountains, or ridges; that the erosion of the river-channels kept pace with the slow, uniform, long-continued elevation, and thus these enormous gorges may be accounted for.

In my Annual Report for 1872, page 85, I called attention to this feature, and it is undoubtedly applicable to all the great rivers of the West, to the Snake and Columbia Rivers flowing through the vast basaltic walls to the Pacific Ocean, to the Colorado of the West, that has worn out its cañon for more than two hundred miles from half a mile to a mile in depth, and to the Missouri and Yellowstone Rivers from their sources to their entrance into the plains. In the Annual Report for 1872, I made the following remarks:

Another interesting point I have reserved for discussion at a more favorable time is the formation of cañons and valleys of rivers, which enter into the scenery of the country as a most conspicuous feature. The fact that the streams seem to have cut

their way directly through mountain-ranges instead of following synclinal depressions indicates that they began the process of erosion at the time of the commencement of the elevation of the surface. This is shown all along the valley of the Yellowstone, and more conspicuously in the valleys of the Madison and Gallatin, which have carved immense cañons or gorges directly through two of the loftiest ranges of mountains in Montana. We believe that the course of these streams was marked out at or near the close of the Cretaceous period; and as the ranges of mountains were in process of elevation to their present height, the erosion of the channels continued. The details of the observations which contributed to form this opinion would occupy a chapter or two.

I would be glad to find the leisure at some future period to extend these observations in detail all over the country west of the Mississippi, so far as it has been explored. It should be done by some one; but as these notes are intended simply to convey brief descriptions of the sections accompanying them, it cannot be done at this time. The sections, however, will, I think, be acknowledged by all geologists and geographers to convey marvelously true pictures of the surface features of a remarkably interesting region.

NOTES ON THE TERTIARY AND CRETACEOUS PERIODS OF KANSAS.*

By B. F. Mudge.

The State of Kansas is about four hundred miles long from east to west and about two hundred miles (three degrees) in width from north to south. Its average altitude above the level of the sea, by the List of Elevations by H. Gannett, United States Geological Survey, Miscellaneous Publications No. 2, is not far from 1,780 feet. The lowest point is at the junction of the Kansas and Missouri Rivers, and is 750 feet. The highest is in Cheyenne County, about 4,000 feet. The altitude of Monotony station of the Kansas Pacific Railway on the west line of the State is 3,792 feet. The Atchison, Topeka and Santa Fé Railway station at Syracuse, Arkansas Valley, also near the west line, is 3,425 feet.

By inspection of the map of the State, it will be seen that the rivers drain the country in a southerly and easterly direction. As there is not a waterfall on any of the streams 7 feet in height, the descent is gradual, averaging 7½ feet to the mile. The State is so well drained that there are very few valleys with stagnant ponds, and there is not a peat-swamp of fifty acres within its boundaries.

STRATIGRAPHICAL GEOLOGY.

A general vertical section of all the formations seen in Kansas would be in descending series as follows:

I.—Quaternary system:

- Alluvium.
- Bottom prairie.
- Bluff or Loess.
- Drift.

II.—Tertiary system:

- Pliocene.

III.—Cretaceous system:

- Niobrara.
- Dakota.

V.—Carboniferous system:

- Permian.
- Upper Carboniferous.
- Coal-measures.
- Lower Carboniferous.

* There has been no State geologist during the past ten years, and the information embodied in this sketch was nearly all obtained while engaged in other duties. In relation to the classification of fossils, I have consulted the works of Lesquereux, Meek, Marsh, and Cope.

In this paper we propose to describe only the Tertiary and Cretaceous deposits, as they are a part of the formations first described in the reports of the United States Geological Survey under Dr. F. V. Hayden. It will be seen by inspection of the map that they occupy the western two-thirds of the State. The outlines of the formations cannot be given in detail where the scale is so small. But one feature must be kept in mind. It is this: The dip of the strata in all parts of the State is so slight, averaging about five feet to the mile, that, as you travel to the northwest, the more modern strata, or deposits, are always seen first on the tops of the hills, and gradually descend into the lower grounds and disappear under the still more recent deposits. Thus, on the border of the Pliocene Tertiary and Cretaceous there is a belt about twenty miles in common, where the former occupies the higher and the latter the lower portions of the country. In this way the Tertiary covers about 9,000 square miles of Kansas, consisting of 6,000 covering the entire northwest part of the State and 3,000 interspersed with the Cretaceous along its southeastern boundary.

II.—TERTIARY SYSTEM.

PLIOCENE.

This geological area has been but little examined, and consequently our knowledge of its local features is quite limited. Professors Cope and Marsh have both, in their visits to the Cretaceous, made some casual notices of the southern portion, without spending time in searching for its fossils.

During the summer of 1874 and 1875, we spent much time along the line of its union with the Niobrara, and thus became acquainted with its outlines and a few of its fossils. The line of demarkation, at most points, is very clear and well defined. In numerous places we have found the fossil bones of the mammalia of the Pliocene within ten vertical feet of the marine shells and fish of the Cretaceous; and in slides we frequently found them intermingled. The contrast was remarkable as hardly a single type was common to both.

The material of the Pliocene deposits consists of sandstone of various shades of gray and brown, occasionally whitened by a small admixture of lime. The lower strata are usually composed of finer sand than the upper, and much more loose and friable in their texture. The overlying beds are of coarser ingredients, consisting of water-worn pebbles of metamorphic rocks—quartz, greenstone, granite, syenite, and sometimes fragments of fossil wood from an older formation. These portions of the deposit, when crumbled and the finer parts washed away, have much the appearance of drift, and have been mistaken for it.

The sandstone is usually friable, crumbling on exposure to the atmosphere. When more compact, its mechanical construction is so irregular as to render it almost entirely unfit for a building-material. When firmly consolidated, it forms the hill-tops of the table-like eminences along the line of the boundary of the Pliocene and Cretaceous formations.

At Breadbowl Mound, Phillips County, it is about 400 feet above Deer Creek, and at Sugarloaf Mound, in the western part of Rock County, it is about 300 feet above the Solomon River. In these hills as in many others, the upper strata belong to the Pliocene, while the

bases are of the Niobrara. Farther west it forms the whole of the visible outcrop, and the mounds are not so prominent.

On Prairie Dog Creek, in Norton County, it is 400 feet in thickness, and in the extreme northwestern part of the State we have reason to believe it is still thicker. The various strata are not clearly defined or regular in line of deposit, and the continued thickness cannot be easily discovered. The formation, like all others in the State, appears to dip slightly to the northwest. It is conformably, or nearly so, upon the Cretaceous.

In the southern portion of the Pliocene, in the vicinity of Fort Wallace and Sheridan, the hill-tops are covered with a stratum about 8 feet in thickness, very hard and siliceous. The material varies from coarse flint-quartz to chalcedony. The latter mineral shades from milk-white to transparent, sometimes presenting a semi-opal appearance. The so-called moss agate is found in the upper few inches of the stratum.

Over a considerable portion of the Pliocene no fossils are to be seen; but at other points they are somewhat abundant. They are of modern type, represented by bones of deer, beaver, a large animal of the ox kind, two species of the horse, less in size than small Indian ponies, a wolf, ivory from the elephant or mastodon, bones of the rhinoceros and camel, and also remains of undertermined character. In addition to these mammalia, we find the bones and carapace of a large fresh-water turtle 5 feet in length.

All the bones are firmly fossilized, and most of them changed to a hard, compact silica. The most interesting of these is the ivory. In the process of petrifaction, the tusk must have been so softened as to admit the intermixture of black oxide of manganese in solution, which then crystallized in delicate sprigs. The ivory was next silicified into nearly pure quartz, with the usual hardness of that substance. Thus we have the ivory converted into the so-called moss agate. Some fragments could not be detected, by the ordinary observer, from the usual specimens of that gem.

This ivory is found in fragments in the extreme upper portion of the deposit, and we were at first inclined to call it Post-Tertiary; but the peculiar fossilization, similar to some of the other bones, induces me to think that it belongs to the close of the Pliocene.

The remains of the horse are apparently the most common, the teeth and jaws being found from Smith County to the vicinity of Ellis, in Ellis County. One is a species of the celebrated three-toed horse, having three hoofs coming to the ground. In the northern part of Ellis County, our party, in 1875, found the feet, with the three toes in excellent preservation.

In most cases the bones are badly broken, and much of the skeleton missing. A full and careful examination of the Pliocene of Kansas will undoubtedly furnish some valuable fossils, illustrating the mammalia of the period, and give to science some new species.

The Eocene and Miocene have not yet been discovered in Kansas, unless the specimen of the three-toed horse, found in Ellis County, should prove to be the *Anchitherium* of the Miocene. It was imbedded in the lowest part of the deposit, within 10 feet of the Niobrara limestone. Further examination of this formation is desirable.

II'.—CRETACEOUS SYSTEM.

1.—NIOBRARA.

2.—DAKOTA.

The Cretaceous in Kansas covers an area of over forty thousand square miles, or more than half of the surface of the State. The Pierre and Fox Hill groups of Hayden, and all equivalents of those periods, are entirely wanting. The Benton group also appears to be absent. The Cretaceous is, therefore, represented in Kansas by the Niobrara and Dakota only. The line of demarkation between the Pliocene and Cretaceous is well defined and sharp. Adjoining the Permian easterly, it is not so clear; yet some recent examinations, made in company with Prof. O. St. John, show that the boundary is not difficult to trace. We have never been able to find any fossils of the Jurassic or Triassic, the beds of the Cretaceous resting conformably or nearly so on the Permian.

That portion south of the Arkansas River has been little examined, either by myself or others, but appears to be represented by the Fort Hays and Dakota groups.

1.—NIOBRARA.

a.—Niobrara.

b.—Fort Hays.

The Niobrara, or its equivalents in time, is well represented. It is divided into two clearly-defined portions, by a massive bed of limestone or yellow chalk, which when fully exposed, where it has not suffered from abrasion, is 60 feet in thickness. It is seen in the valley of the Smoky, southwest of Fort Hays, as well as seven miles west of that place, and at various points to the northeast, crossing the Solomon just above the Forks, near Osborne City, and entering Nebraska in Republican Valley, near where that river crosses the State line. It is composed of layers of yellow chalky limestone, from 1 to 3 feet in thickness. It makes an excellent building-material, working easily, yet sufficiently compact to be used for stores or dwellings. At Hays, the school-house and court-house are built from it; and ten miles west of that place the Kansas Pacific Railway has opened a quarry for supplying stone for use along its line. It also burns to a good quicklime. The massiveness and persistence of this stratum make it a well-defined geological horizon. Below this line, as well as in it, vertebrate fossils are few, while above it they are numerous and of varied type. Its fossils are *Inocerami*, fragments of *Haploscapha*, *Ostrea*, with occasional remains of fish and Saurians. The vertebrates are always so rare that we never wasted our time in hunting them in this stratum; still our largest Saurian, *Brimosaurus* of Leidy, was found in it in Jewell County.

a.—Niobrara proper.

The Niobrara in Kansas differs from the same deposit on Niobrara River. The upper portion, which we shall call Niobrara proper, or simply Niobrara, is very unlike the lower, which shades imperceptibly into deposits like the Benton. The two divisions differ in a very marked

degree both in the character of the fossils and in physical appearance. This Niobrara occupies a belt of the country next adjoining the Pliocene, about thirty miles in width in the northern part of the State, but gradually widening to more than twice that extent in the Smoky Hill Valley. At the latter district, it extends from the western line of Ellis County to the Colorado boundary. It is composed of chalk and chalky shales. The former is of various shades of color from buff to pure white, and is seldom sufficiently hard to be used as a building-material. Some of the buildings at Fort Wallace were constructed of it, but did not prove substantial. The whiter portions are almost pure carbonate of lime, and cannot be distinguished from the best specimens of foreign chalk. Professor Dana, in the last edition of his Manual of Geology, p. 455, says there is no chalk in North America except in Western Kansas.

G. E. Patrick, professor of chemistry in the Kansas University, has published, in the Transactions of the Kansas Academy of Science, an article on this chalk, from which we extract the following remarks, with his analyses:

Examined under the microscope, it appears perfectly amorphous—a simple aggregation of shapeless particles. The Rhizopod shells, which almost universally occur in the chalk of the Old World, sometimes comprising nearly its entire substance, seem to be quite wanting in our Kansas chalk. With a good microscope, and a high power, I have been unable to detect a trace of them.

The amount of impurity varies, of course, in different samples of the chalk, but in no specimens that I have seen does this amount exceed 15 or 16 per cent. Two samples yielded, upon analysis, the figures given below. No. 1 was a fine specimen of snowy whiteness; No. 2 had a little yellowish tinge, and was as poor a sample as I could select.

	No. 1.	No. 2.
Moisture	.34	.58
Insoluble in acids (silica, lime, and alumina)	.69	11.40
Alumina (little oxide of iron)	.43	.97
Ferrous carbonate	.14	2.83
Calcium carbonate	98.47	84.19
	100.07	99.97

This chalk is found at various strata, in thickness varying from one to eight feet. It differs in purity and other features, in the same stratum, in different localities. Unlike the European chalk, it never contains flint nodules.

The shales of this division contain lime mingled with clay and sand in varying proportions. They are harder than the chalk, requiring the pick in extricating the fossils. They are of all shades of slate-color, sometimes bleaching on exposure to the weather. Near Fort Wallace, some strata are so much like the Benton in Nebraska, that Professor Hayden, on a hasty inspection, mistook them for a portion of that group. (Final Report on Nebraska, p. 68.)

These shales, in some localities, are traversed by seams, from one to six inches in thickness, of firm, pure calc-spar, usually in flat crystals. Inclosed in these seams are small crystals of barite. At Sheridan, Wallace County, we find the latter spar in the dark shales. One beautiful crystal, of a rich amber-color, weighed eight and one-fourth pounds.

The darker shales also sometimes contain numerous small lenticular nodules of pyrites, frequently in fine crystals.

This Niobrara is from 75 feet in Trego and Ellis Counties to 200 feet in Rooks County. The fossils are scattered very similarly in all this thickness; some localities will furnish more from the chalk, while others will give more from the shales. We hunt for fossils in all alike, and on the whole with equal success.

A few marine plants are found, but no land vegetation, except an occasional fragment of fossil wood. The absence of terrestrial plants is the more remarkable, as extinct birds and numerous amphibians indicate that dry land must have existed.

One fine species of crinoid of a new genus was occasionally found by our party in 1875. No radiate had before been seen in the Kansas Cretaceous.

Of mollusks, the most common are *Ostrea congesta* and *Inoceramus problematicus*. Less common, but still seen in many strata, are fragments of the large *Haploscapha*, with occasionally a perfect specimen. Another large bivalve we have never seen described measures from 30 to 33 inches in length. It is thin, with a transverse fiber like the *Inocerami*, and always lies crushed flat in numerous fragments, but lying in their normal position. A few *Gryphea;* also fragments, frequently weighing ten pounds, of a large *Hippurites* near *H. Toncasianus*. Near Sheridan, we recently discovered a bed of *Baculites ovatus*. Almost all the shells and fragments are covered in part by the *Ostrea congesta*, which abound everywhere.

But the great feature of this subdivision of the Cretaceous consists in its varied and rare forms of vertebrate fossils. Two seasons, of six months each (1874 and 1875), have been spent by myself with two assistants in collecting these vertebrates for Yale College, and yet the deposit is but partially explored, and we are constantly discovering new forms.

The least interesting are the fish, which have, however, given us many new species and some new genera. The small ones are nearly entire, but the larger are represented only by well-preserved portions of the skeletons. Teeth of Salachians were quite common. At one locality over 400 were collected in an area of 30 inches, and apparently from the jaws of one individual—a *Ptycodus*—and all in excellent preservation. Professor Cope, in his "Cretaceous Vertebrata," has described thirty-six species, and some twenty others have quite recently been found. In 1872, only twenty-four species had been collected from Kansas. The most novel is a new genus (three species), which had a snout appended to the skull, like the sword of the sword-fish, but conical in shape, composed of a compact bundle of fibers. In the largest species, this snout is about fifteen inches long and one and a half in diameter at the base. Professor Cope has a representation of a portion of the jaws in Plate XLVIII, figs. 3–8, under the name of *Erisicthe nitida*. But, unfortunately, his specimen did not embrace the snout or much of the skull, so that a correct idea of the fish is not obtained from his description. Professor Marsh has a dozen specimens, recently obtained by us, from which a more detailed description may be made.

In individuals, the fish were quite numerously represented. In the season of 1875, our party saw, according to my note-book, 1,207 specimens, without counting the teeth of sharks. Many of these, however, were so fragmentary that we did not collect them. The genera *Portheus* and *Empo* were most abundant.

Several species of marine turtle have been obtained. One described by Cope, *Protostega gigas*, was 15 feet in the expanded flipper. The type is embryonic. This is seen in the structure of the ribs, which are more free and detached from the dermal plates of the carapace than those now living. The other species were much smaller.

Less in number but of more importance are the reptiles of the crocodile and Saurian type. My note-book shows 476 specimens seen by our party in 1875, of which one-half might be called good, and some of

them equal, if not superior, to anything before found in Europe or America. Professor Cope, in the work above quoted, has made a list of all the genera and species now known in the Cretaceous, which shows fifty-one hitherto described, of which Europe furnishes but four, and Kansas twenty-six. To this number must be added six or eight which have been discovered by our party within two years, which are now in possession of Professor Marsh, who will soon publish a technical description of them.

New Jersey comes next, furnishing fifteen species. Although this formation extends quite widely into Nebraska, but few vertebrates have been found within that State. They have been collected most abundantly in the Saline and Smoky Hill Valleys, and nearly all from the Niobrara proper, above the massive limestone of the Fort Hays division. It must be recollected that this deposit is never over 200 feet in thickness.

The Saurians are of all sizes. One from Jewell County was about 70 feet long, while two species were only 6 feet. Most frequently they were from 25 to 40.

The specimens are frequently represented by a few bones washed out and lying exposed. But the best are obtained by finding a projecting fragment, and then following the skeleton into the compact shale or chalk. This sometimes requires much hard labor, but is the most satisfactory, as the fossils are, in such cases, in a better state of preservation. A single specimen has cost us as much as six days' labor. As the bones were sometimes friable, sketches of the best specimens were made before removal. The fossilizing material is lime combined with a little silica.

Coprolites of fish and Saurians are frequently found, containing the remains of the food of the animal. Small fish appeared to be the most common food; but in one instance a rare crustacean was found preserved in this way. The coprolites are not so hard as those of Europe, being little firmer than chalk, and finer-grained.

The following analysis of a Saurian coprolite from Wallace County is by George E. Patrick, professor of chemistry in the University of Kansas:

Moisture	1.22
Organic matter	.42
Oxide of iron and alumina	29.99
Lime	24.31
Alkalies, small amount, undetermined.	
Silica (combined)	.19
Phosphoric acid	34.88
Carbonic acid	7.05
Sulphuric acid	1.92
	99.98

In some cases, the undigested organic matter (bones) was one-fourth of the whole weight.

From this deposit, Professor Marsh has described three species of Pterodactyls, new to science, and Professor Cope one. But as the specimens were not perfect, and two are quite similar, it may be concluded that they are identical. One of a new genus was recently found by me, and is in the hands of Professor Marsh. Those from Kansas vary from the European species in their great size, the largest foreign being but little over 10 feet in extent of wing, while the smallest of those from the Niobrara is 15 feet and the largest are fully 25 feet. Fragments of the bones are frequent, but usually in poor preservation, in strong contrast, in this respect, with the other vertebrate remains. The long bones, being very hollow, were compressed to the thickness of one-tenth of an inch, and exceedingly friable. The articulations, being

thicker, are firm and better preserved. The bones of the head were seldom found. In one instance (of *P. ingens*), I uncovered a hand, with the four long bones of the wing-finger, as they lay in place, and found them measuring respectively 24½ inches, 20¾ inches, 14½ inches, and 9 inches; or 5 feet 8¾ inches in total length. The width of the first, as it lay compressed to one-tenth of an inch, was about 2 inches. My note-book shows seventy-two individual specimens seen in 1875; but little more than half could be saved, much as we valued this rare fossil. In some instances, on opening a piece of chalk, the outline could be distinctly seen, but the bone crumbled to dust.

In Dr. Coues's Key to North American Birds, published in 1873, Professor Marsh has given a list of the fossil birds from the Cretaceous of North America, at which time thirteen species were known, all first described by himself. Of these, five are from the Niobrara beds of Kansas. Only one Cretaceous bird has been found in Europe. Two of ours are aquatic, allied to the cormorant; but the other three are of a new order (*Ichthyornithes*), and are so anomalous as to be provided with jaws and teeth. One, *Hesperornis regalis*, is between 5 and 6 feet high, an aquatic diving-bird, with rudimentary wings, incapable of flight. The others, *Ichthornis* (two species), are small, but with strong wings, of great powers of flight. The latter genus, in addition to its sharp enameled teeth, presented another singular feature in the vertebra, which were biconcave, of the true fish type. The bones of the legs and wings were of the usual bird structure. The first specimen of this was found by the writer, and described by Professor Marsh in the American Journal of Science, vol. iv, p. 314, and illustrated in vol. x, p. 402. Bird-bones being exceedingly difficult in preservation, the number found is very small.

The soil of this division consists of the fine, black loam, so common to the West, and is, on the high prairie, from 1 to 3 feet deep. Were rain more abundant, it would be a rich farming-region. It is a good grazing-country. The following analyses of soils, collected by S. W. Williston from the Smoky Hill Valley, were made by George E. Patrick, professor of chemistry in the University of Kansas. No. 1 is high-prairie loam; No. 2 is from "bottom" lands. Neither soil had ever been cultivated.

	No. 2.	No. 1.
Water	1.895	3.449
Organic matter	3.039	5.224
Soluble in cold hydrochloric acid:		
Oxide of iron	1.503	1.778
Alumina	.557	.721
Lime	4.268	1.618
Magnesia	.422	2.084
Potassa	.214	.202
Soda	.038	.002
Silicic acid	.050	.023
Sulphuric acid	.041	.075
Carbonic acid	3.510	2.567
Phosphoric acid	.173	.118
Sodium chloride	.003	.009
Insoluble in cold hydrochloric acid	84.287	82.127
	100.000	100.000

b.—Fort Hays division.

The massive stratum of limestone above described, together with all the deposits above the sandstones of the Dakota, I shall call the Fort Hays division.

Professor Hayden, in his Final Report of the United States Geological Survey of Nebraska and Adjacent Territories, p. 67, says:

At Wilson's station, I saw the chalky limestone of the Niobrara group filled with *Inoceramus problematicus*. A part of the bed is in slabs or thinnish layers, as it usually appears wherever it occurs south of the Missouri River; but a part also is more arenaceous and rust-colored. Between the two hundred and forty-fifth and two hundred and fiftieth milestone west, the road cuts through No. 3 (Niobrara) very distinctly, the whole country appearing to be underlaid by this rock.

As this deposit thus seen and described by Professor Hayden rests directly on the Dakota, and all those which he supposed might possibly be Benton, are clearly above the strata seen at Wilson's station, the Benton is not seen in Kansas. The lower portion of our Fort Hays may be an equivalent of the upper portion of the Benton, though there does not appear to be any line of demarkation, either by fossils or physical structure.

At Wilson's station and at other places in the same geological horizon, to the thickness of 140 feet, it is composed of shales and thin layers of limestone. The latter are filled quite largely with *Inoceramus* and a few other marine shells, and occasionally with fish-remains. The shales are variable in color, hardness, and composition, lime and clay predominating. This deposit is variable at the same horizon at different points, containing no thick bed of limestone. To make a section at any particular locality would be of little value unless half a dozen others were made for comparison.

The only persistent feature is a thin stratum of buff sandy limestone, in the upper portion, never over 10 inches in thickness. It extends from Smoky Hill Valley northeasterly into Nebraska. It contains *Inoceramus problematicus*, *Gryphea*, *Belemnite*, and an *Ammonite*, all poorly preserved, and, excepting the first, too indistict for specific indentification. It is much used as a building-stone on the whole line named. It is soft, fine-grained, and easily wrought, and its color is pleasing to the eye.

In the Arkansas Valley, west of Fort Dodge, the Fort Hays division is represented by loose sandstone. Next above this is the friable, bluish-black, or slate-colored shade which lies immediately under the massive limestone. It abounds in concretions, or septaria, of all sizes from 1 inch to 6 feet in diameter. The body of the concretions is of hard clay-marl with cracks lined with beautiful crystals of calc-spar. These cracks frequently extend to the outside, and are then filled with a light lime, which gives them fanciful markings, inducing several persons to send small ones to me as "fossil turtles". This stratum is well exposed near the railroad, a few miles west of Fort Hays, and in most places where the massive limestone lies on the high bluffs. It is about 60 feet in thickness, and frequently contains fine clusters of compound crystals of selenite. It affords a few fish and saurian remains. It is more noted, especially in the Saline and Solomon Valleys, for the number and variety of its *Ammonites*, embracing a dozen species, from 1 to 30 inches in diameter. The largest are always in fragments, but some of the smallest are nearly perfect. Usually a portion of the bright pearly shell is still to be seen. A species of *Scaphites* near *larvæformis* is also found in the small concretions; also several *Inocerami*, one near *I. Nebrascencis* of Owen.

The physical features of this stratum, which are very uniform, are similar to the Benton in Northern Nebraska, but its fossils are different.

The total thickness of the Fort Hays group is 260 feet.

The Dakota group includes all the Cretaceous east of the Niobrara. As no fossils of the Triassic or Jurassic have yet been discovered, after ten years' search, we conclude that the Dakota rests directly on the Permian. While the dividing-line has not usually been very well defined, yet in a few instances the fossils of the Permo-Carboniferous and

Dakota groups have been collected within 35 feet vertically and one-half mile horizontally.

The material of this deposit is formed very largely of brown and variegated sandstone, of all degrees of compactness, from that which crumbles in the handling to that which requires a sledge-hammer to break it. This extreme hardness is, in most cases, owing to the presence of iron, in the condition of oxide and silicates. Sometimes poor limonite is seen. In some places, in every county where it abounds, it affords a good building-material. It is frequently interstratified or overlaid by clay-shales, of almost all colors. Many ledges give concretions of fanciful forms, sometimes hollow, or with the center filled with loose sand. Some of the hollow concretions are sufficiently large to be used by the farmers as feeding-troughs for hogs and cattle. In a few localities they assume the form of tubes of various sizes, some being 3 inches in diameter and 3 to 8 feet in length. These concretionary deposits are sometimes glazed and distorted, as if they had been subject to the action of fire; but the cause is the oxidation of iron, and not any application of heat. Such specimens of sandstone frequently inclose well-preserved dicotyledonous leaves.

The fossils of the Dakota are very unequally distributed over its area. In searching for the marine mollusks, we have found but two localities, both in the western part of Saline County, in the vicinity of Bavaria. In one of these spots, covering a few acres, we procured twelve species new to science. These are figured and described in Professor Meek's work on the Invertebrates, now in press. The other locality furnished a less number.

In collecting fossil leaves, we have frequently examined every visible outcrop for fifteen or twenty miles without finding a specimen; then perhaps a single square mile would present several good localities. In this irregular manner we have collected specimens from Washington County to Fort Larned, a distance of one hundred and fifty miles. The fossil plants are usually obtained from thin layers, or strata, extending in a horizontal position along a ravine or around a hill. They may occur at several places in the same vicinity, but usually without any connection. The fossil flora is almost entirely represented by leaves, though a few specimens of fruit, imperfectly preserved, have been collected; also some poor fragments of wood and bark. The leaves, however, are usually in excellent preservation, the veins and veinlets as they lie imprinted on the stone being frequently as clearly visible in all their outlines as those just taken from the living tree.

Professor Lesquereux has recently made a report, issued by the Department of the Interior, on the Fossil Flora of the Cretaceous Dakota Group, which is one of the most valuable monographs published in our country. He describes one hundred and thirty-two species, distributed among seventy-two genera and twenty-three orders, of which one hundred and seven species of nineteen orders and fifty-two genera are dicotyledonous plants. Of these, more than one-half have been collected in Kansas; and about twenty of the new species were described by Professor Lesquereux from specimens discovered by the writer. To these are to be added twenty-six new species described by the same author in a recent bulletin (VII of No. 5, second series) of Hayden's reports. Additions to these are constantly being made. They are found at all depths in the Dakota, from within 35 feet of the Permian to within 40 feet of the Fort Hays limestone.

Although all the species are extinct, yet nearly all the of genera are now existing, and all are of marked modern type. There are eight species of conifers, five of poplar, six of willow, eight of oak, six of platanus or

buttonwood, seven of sassafras, five of magnolia, one fig, one palm, and two of cinnamon. The last four were probably hardy species of their kinds. Still they indicate a warmer climate than now exists. When we recollect that at the period of their growth, this part of the country was nearly on a level with the ocean, and the dry land was comprised principally of a few islands, the variance of the climate is easily explained. These are "the first known of the great modern group of Angiosperms," "and the ordinary fruit-trees of the temperate zones," for leaves of the *Pyrus* and *Prunus*, allied to the pear and plum, have also been found.

The contrast between this fossil flora and the plants of the older formations is very strong, while its resemblance to those now living is equally remarkable. The interest attached to this numerous variety of modern plants is enhanced by the fact that in the earlier formations no dicotyledons are found, the conifers which come down from the Devonian age being the highest type. But in our Dakota and the corresponding age in Europe we have a sudden influx of new types covering nearly all the forms now living. The large proportion of orders and genera to species is very remakable. The numerous indications show that the trees must have grown on islands near the shore-line, and that the leaves were imbedded in the marine sediment immediately after dropping. Worm-borings are also found in the same strata with the leaves. A few fish and one saurian (*Hyposaurus rebbii*) have been found in this group.

In the Dakota group, there are a few veins of brown lignite, which is always an inferior variety of coal. The most important seam extends irregularly, and with frequent omissions, from the State line in Washington and Republic Counties, southwesterly to the Arkansas Valley. It varies in thickness from 10 inches to 40; but usually a portion of this thickness includes seams or layers of clay-shale. This lignite contains a large percentage of ashes; but a more objectionable feature is its tendency to crumble on exposure to frost. This alone renders it almost worthless as a marketable coal. At some localities it has much pyrites, with sulphur so free as to cover the deposit with a yellow coating. This coal sometimes takes fire by spontaneous combustion. Notwithstanding these defects, it becomes of value in sparsely-timbered counties, by furnishing to the settlers a cheap fuel, costing only the time and labor necessary to dig and convey it to their farms. It is usually mined at the surface in the open air, by "stripping," *i. e.* removing the few feet of soil or shale that overlies it. An average outcrop will yield at least a ton for a day's labor. It is found in Washington, Republic, Cloud, Mitchell, Lincoln, Ottawa, Saline, Ellsworth, McPherson, Rice, Barton, and perhaps some adjoining counties. The average width of the Dakota is less than fifty miles, being somewhat less than that in the north part of the State, and more on the Smoky and Arkansas Rivers. The dip is to northwest and very slight. It is difficult to decide the amount, but it does not appear to be on the average more than 5 feet to the mile. It is conformable to the Fort Hays lime formation above it. It corresponds very nearly to the Cretaceous of Swallow's Report, p. 9, and also to Nos. 2 and 3 of his Triassic.* The maximum thickness of this group may be 500 feet. It is difficult to estimate the thickess, as the larger portion of the material consists of sandstone, much of which was originally thrown down in oblique deposits.

The total thickness of the Cretaceous in Kansas we estimate to be 960 feet.

*The other numbers of his Triassic belong to the Permio-Carboniferous.

NOTES IN RELATION TO THE ACCOMPANYING CONTOUR-MAP OF THE UNITED STATES.

By Henry Gannett, M. E.

I have been engaged for several years in collecting elevations in the United States, particularly in that portion west of the Mississippi River. In connection with this work, I have made a quite extensive study of the geography, both horizontal and vertical, of the country, having had access to nearly all sources of such information extant.

By means of the numerous reconnaissances and surveys of different parts of the West, there is scarcely any part of this vast area of which the *general* features at least are not known. The necessity for further reconnaissance, as such, no longer exists, while the need of actual surveys, based on exact methods, increases year by year, as the work of settlement goes on. In the accompanying map, I have sought to embody some of the results of my studies. It represents approximately and as nearly as the information available at present will enable me to do it, the locations of contour-curves over the country.

The vertical distance between the curves is 1,000 feet.

This map is published merely as a beginning in this direction, and as much with a desire of gaining information by criticism as of imparting knowledge on the subject.

The map on which the curves were drawn, and of which this is a photo-lithographic copy, is that used by the Census Bureau for their atlas. It is not all that could be wished for the purpose, as it contains many errors in drainage, geographical positions, &c., due to the fact that the latest geographical work is not represented upon it. In general, I have made the contours conform to the drainage; but in a few cases, where this would necessitate marked errors in the curves, the course of the drainage has been neglected, and the contours have been drawn as I know them to exist, as in the case of Preuss Lake, Utah, which has lately been proven to have no existence, and the mouth and lower course of the Rio Dolores in Eastern Utah, which have been sadly misplaced by map-makers since the time of Captain Gunnison. The scale of the map is smaller than I should wish, and makes it impossible to represent properly many features which could be brought out on a larger map.

Exact measurements of elevation above sea-level are in this country entirely unknown, except near the coast. No leveling for scientific purposes, on any considerable scale, has been done; and the levels of railroad and canal lines, though at first they might seem to be all that is required, on examination are found to be as conflicting as possible. No two lines give the same height for the terminus. The profiles of the railroads, when compared, present a mass of contradictions almost beyond belief. The discrepancies, however, are due, not to the instrumental work, but to the office-work, the computations, the connection of different sections, &c. The matter is greatly complicated by uncertainty concerning the identity of datum-planes, especially when such datum-planes are given as mean, high, or low water in lakes or rivers.

To untangle this mass is an enormous labor, and one perplexing in the extreme. Many have undertaken it, and have given it up in despair. In 1874, Mr. J. T. Gardner, then connected with this Survey, undertook a part of this labor, and succeeded in carrying it through with a considerable degree of success. His problem was, to obtain the true elevation of Denver, Colo., which serves as a hypsometric base for our work in Colorado. To this end, he connected a number of lines from the Atlantic and Gulf coasts, rooted out nearly all the errors, and finally obtained results for the heights of several of the most important railroad-centers, which, from their close agreement, show a strong probability of being correct. Should these results, on the application of further tests, prove trustworthy, they will form a frame-work, by use of which the problem will be simplified very much.

Elevations measured by barometer are liable to large errors, unless the work is done under the very best circumstances. The most potent causes of error are too great distance, horizontal and vertical, from the barometric base. In the earlier days of exploration in the West, it was impossible to obtain even tolerable conditions for the execution of hypsometric work. Hence, naturally, the earlier measurements of elevations in the West are found to present a wide range of error, some being changed scarcely any by later and more reliable measurements, others being several hundreds of feet—indeed, in some cases reaching a thousand feet—from the truth.

In constructing these curves, though I have made use of the many thousands of elevations in my possession, I have borne in mind that elevations of isolated points merely, without a knowledge of the surrounding topography, are of little use. Indeed, in many cases they are worse than useless, as they may tend to mislead.

The *mean* heights of mountain-ranges have been expressed as nearly as possible. They will, no doubt, be subject to much criticism, as many of them are based on insufficient information, and my estimate of the *mean* heights of others, based on the heights of a few peaks, may not be correct.

In the cañons of the Colorado and Green Rivers, I have thought best, owing to the small scale of the map, to run the contours into a single line.

The sources of information consulted and made use of in this work are almost numberless. I will enumerate the principal ones. For a knowledge of the Appalachian system and the country adjacent, I am indebted mainly to the article by Professor Guyot on the Appalachian system, published in vol. xxxi (1861) of Silliman's Journal; also, in various State geological and geographical reports, there is much material of value concerning the Eastern States. Information concerning the valley of the Mississippi is scattered far and wide, and to specify authorities would fill a volume. Reports of State and General Government surveys and profiles of railroads have supplied the greater part of this information.

On the slope of the great plains, between longitudes 96° and 104°, the contours are controlled largely by the plotted heights. These heights have been collated from, first, the profiles of the several railroads which cross the plains, the Northern Pacific, Union Pacific, Burlington and Missouri River, Kansas Pacific, Atlantic and Pacific, Arkansas Valley, and others of less importance; and, second, from the profiles of the routes of the numerous expeditions which have crossed the plains in various directions.

The Llano Estacado and the western part of Texas are known mainly

from the reports and maps of Pope,[1] Whipple,[2] and Marcy;[3] the valley of the Canadian, from Whipple;[2] that of the Arkansas, from Emory,[4] Gunnison,[5] and the Arkansas Valley Railroad; the Kansas River and Smoky Hill Fork, from the Kansas Pacific Railroad; the Valley of the Republican, from Frémont[6] and Stansbury;[7] that of the Platte, from the Union Pacific Railroad. Information concerning the Missouri River and the country lying between that river and the Black Hills is derived from the work of Warren,[8] Raynolds,[9] and Ludlow.[10] Stevens[11] gives much information concerning the country east of the Missouri, and the Northern Pacific Railroad furnishes a profile across it. Facts and figures concerning the plains of the Upper Missouri come mainly from Stevens.[11]

The divides between the valleys have been crossed in many places, and profiles made, and in no place do they show much rise above the valleys.

The principal authorities consulted in regard to the Black Hills are the reports of Warren,[8] Raynolds,[9] Ludlow,[10] and Jenney's map.[12]

Proceeding westward and entering the mountains, isolated elevations become of less value, while a knowledge of the general topographic features correspondingly increases in value.

For a knowledge of the topographic features of New Mexico, I have consulted the reports of the United States expeditions which have crossed that Territory; principal among them are Emory,[4] Whipple,[2] Ives,[13] Parke,[14] and Simpson.[15] The mountain and plateau regions of Colorado are from the work, published and unpublished, of this Survey. The plateau country adjacent to the Green and Colorado Rivers is from the published, and, through the courtesy of the geologist-in-charge, the unpublished, work of the survey in charge of Maj. J. W. Powell.[16] The country of the Lower Colorado is known from Ives's[17] report, and the

[1] Pacific Railroad Reports, vol. ii.

[2] Pacific Railroad Reports, vol. iii and iv.

[3] Exploration of Red River of Louisiana. Thirty-second Congress, second session, Executive Document No. 54.

[4] Notes of a Military Reconnaissance from Fort Leavenworth, Mo., to San Diego, Cal., by Maj. W. H. Emory, 1846–'47. Thirtieth Congress, first session, Executive Document No. 7.

[5] Pacific Railroad Report, vol. ii.

[6] Report of the Exploring Expedition to the Rocky Mountains in the year 1842, and to Oregon and North California in the years 1843–'44, by Brevet Capt. J. C. Frémont.

[7] Exploration and Survey of the Valley of the Great Salt Lake of Utah. Howard Stansbury. Special session, 1851, Senate Executive Document No. 3.

[8] Reconnaissance of the Dakota Country, 1855. Thirty-fourth Congress, first session, Senate Executive Document No. 76.

[9] Exploration of the Yellowstone River, by Brevet Brig. Gen. W. F. Raynolds, and Geological Report, by Dr. F. V. Hayden. Fortieth Congress, first session, Senate Executive Document No. 77.

[10] Report of a Reconnaissance of the Black Hills of Dakota in 1874, by Capt. William Ludlow.

[11] Pacific Railroad Reports, vol. i and Supplement, and vol. xii, part i.

[12] Map of the Black Hills, W. P. Janney, 1875.

[13] Report upon the Colorado River of the West, explored in 1857 and 1858, by Lieut. J. C. Ives. Thirty-sixth Congress, first session, Senate Executive Document.

[14] Pacific Railroad Report, vol. vii.

[15] Report of an Expedition into the Navajo Country, by Lieut. J. H. Simpson, 1849. Thirty-first Congress, first session, Senate Executive Document No. 64.

[16] Exploration of the Colorado River of the West, in 1869–'72, by J. W. Powell.

[17] Report upon the Colorado River of the West, explored in 1857 and 1858, by Lieut. J. C. Ives. Thirty-sixth Congress, first session, Senate Executive Document.

rest of Arizona from Ives,[1] Parke,[2] Whipple,[3] Sitgreaves,[4] Simpson,[5] Mexican Boundary Survey,[6] and the published results of the survey under Lieutenant Wheeler, Corps of Engineers. Southern California has been explored by Parke,[2] Williamson,[7] Whipple,[3] and, in more detail, by the California State survey.[8] The latter has made detailed study, also, of the greater part of the State, notably of the Sierra Nevada and the Coast ranges. Nevada and Western Utah are known principally from the maps of Wheeler's survey. Beckwith,[9] also gives some information concerning this region. In the neighborhood of the Union Pacific Railroad, the maps of the "Survey of the Fortieth Parallel"[10] under Mr. Clarence King have, so far as published, furnished valuable information.

Information concerning the country of the Bighorn, Powder, and Tongue Rivers is scanty. The only available source is the report of Raynolds.[11]

The work of this survey in Idaho, Wyoming, and Montana[12] fills out a part of the mountain-region of these Territories. The Wind River Mountains and the adjacent country are described in Jones's report.[13] The contours on the Snake River plateau are located from the work of this Survey and from that of Frémont,[14] Wallen,[15] and Lander.[16] In the Main and Bitterroot ranges, the authorities are mainly Stevens[17] and Mullan.[18] Harney's Lake and the northern part of the Great Basin are known from Wallen.[15] The Blue Mountains of Oregon were traversed by Frémont,[14] Lander,[16] and Wallen.[15] The Cascade Mountains in Oregon and Washington Territory are described by Williamson,[19] Stevens,[17] and the Northern Boundary Commission.[20]

The sources mentioned above are those most fruitful in heights and topographic descriptions. They are, however, but a tithe of the whole number of expeditions which have traversed the West. Many important reconnaissances have been omitted, as their results have been superseded by more accurate and detailed work.

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[1] Report upon the Colorado River of the West, explored in 1857 and 1858, by Lieut. J. C. Ives. Thirty-sixth Congress, first session, Senate Executive Document.

[2] Pacific Railroad Report, vol. vii.

[3] Pacific Railroad Report, vols. iii and iv.

[4] Expedition to the Zuñi and Colorado Rivers, by Capt. L. Sitgreaves. Thirty-second Congress, second session, Senate Executive Document No. 59.

[5] Report of an Expedition into the Navajo Country, by Lieut. J. H. Simpson, 1849. Thirty-first Congress, first session, Senate Executive Document No. 64.

[6] Report on United States and Mexican Boundary Survey, vol. i.

[7] Pacific Railroad Report, vol. v.

[8] Report of Geological Survey of California. Geology. J. D. Whitney.

[9] Pacific Railroad Reports, vol. ii.

[10] Geological Map, No. ii.

[11] Exploration of the Yellowstone River, by Brevet Brig. Gen. W. F. Raynolds, and Geological Report, by Dr. F. V. Hayden. Fortieth Congress, first session, Senate Executive Document No. 77.

[12] United States Geological Survey of Montana and Adjacent Territories, 1871, Hayden. United States Geological Survey of Montana, Idaho, Wyoming, and Utah, 1872, Hayden.

[13] Northwestern Wyoming and Yellowstone National Park, 1873, Capt. Wm. A. Jones.

[14] Report of the Exploring Expedition to the Rocky Mountains in the year 1842, and to Oregon and North California in the years 1843–'44, by Brevet Capt. J. C. Frémont.

[15] Wagon Road Report, by Capt. H. D. Wallen. Thirty-sixth Congress, first session, Senate Executive Document No. 34.

[16] Pacific Railroad Report, vol. ii.

[17] Pacific Railroad Report, vol. i, Supplement; and vol. xii, part i.

[18] Military Road Report, Capt. John Mullan.

[19] Pacific Railroad Report, vol. vi.

[20] Paper by George Gibbs, Journal American Geographical Society, vol. iii.

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THE FLORA OF SOUTHWESTERN COLORADO.

By T. S. Brandegee.

Attached to the division of the San Juan as assistant topographer, as much time as possible was given to the botany of the country through which our work obliged us to pass. Under such circumstances, it was impossible to make a complete botanical collection of the district given to our division; therefore no plants were gathered excepting such as seemed to be additions to the flora of Colorado, as published by the Survey in Miscellaneous Publications, No. 4. The collections and notes were almost all made while riding from one topographical station to another.

Early in June we left Pueblo for Southwestern Colorado, via the Mosca Pass, over the Sangre de Cristo. The country was alive with innumerable grasshoppers, busy eating every green thing excepting the leaves of *Juniperus occidentalis* and the cactus-plants. *Opuntia Missouriensis* was in full bloom, and early in the morning, before the grasshoppers had breakfasted upon the newly-opened flowers, presented a magnificent sight. We rode over mile after mile of the Saint Charles and Huerfano Plains, now covered with the red or yellow flowers of *Opuntia Missouriensis*. The mesas, variegated with the different-colored patches of this cactus, presented a striking contrast to their generally dry, barren appearance.

The thickets of *Shepherdia argentea* on the banks of the Huerfano and its tributary streams, and the abundance of *Abronia fragrans* upon the mesas, at once attract the attention of any one familiar with the flora of Northern Colorado. Up the eastern slope of the Sangre de Cristo we meet with *Abies Douglasii*, and at the very summit of the pass find a long-leaved tree of *Abies concolor*. *Pinus flexilis*, scattered here and there by its twisted branches, bears witness to the prevalent direction of the winds. Some fine old trees of *Abies concolor* grow along the little stream which runs down the pass, and near the base of the mountain descend into the habitat of *Pinus edulis*. A camp at the foot of the pass close to the dunes affords an opportunity for examining the vegetation about those mountains of drifting sand. Nothing, not even a blade of grass, grows upon them; but along their base some *Triticum repens*, *Thermopsis*, *Astragalus pictus*, *Psoralea*, have a foothold. The willows continue along the creek until they are almost buried by the sand which has collected about them.

From here to the Rio Grande, the dry level country is very uninteresting botanically. With the exception of the banks and alkaline flats of the lakes, for thirty or forty miles we pass through a Liliputian forest of *Bigelovia*, *Sarcobatus*, and *Atriplex*. Beds of *Heliotropium Curassavicum*, with their pretty white flowers now in full bloom, are scattered over the alkaline flats about the lakes. The sandy beaches of the lakes are the favorite habitat of *Nasturtium sinuatum*. In September, the banks of the streams were yellow with *Bidens chrysanthemoides*, and upon the surrounding plains *Cleome Sonoræ*, with *Aplopappus lanceolatus*, grew in

abundance. These plants, so common about the lakes, were seen in no other place during our summer's explorations.

Up the Rio Grande, as far as to fifteen miles above Del Norte, nothing of interest was noticed; there we first meet with *Berberis Fendleri*, which, after we had crossed the main range, was found quite as plenty upon the western slope.

Wagonwheel Gap, through which the waters of the Rio Grande have barely room to find their way, is a cañon of magnificent beauty, and is very interesting botanically. Although only 8,000 feet above sea-level, *Cryptogramme achrosticoides* flourishes among the loose rock. On the face of the cliffs and among the *débris* at their base, a new *Gilia*, *G. Brandegei*, Gray, was found growing in abundance. But for its yellow flowers, it would have been passed by as *Polemonium confertum*, var. *mellitum*, which it almost exactly imitates in leaves and fragrant viscosity.

At the head of Los Pinos Creek we leave the Rio Grande, cross the Sierra Madre, and come upon the western slope of the Rocky Mountains. The alpine and subalpine floras at this southern latitude are almost exactly the same as those of Northern Colorado. *Pachystima Myrsinites* and *Erythronium grandiflorum* are very common, and *Aquilegia Canadensis* almost entirely takes the place of *A. cœrulea*. Among the common species of *Senecio*, *Sedum*, *Pedicularis*, &c., but two additions to the flora of Colorado were noticed: *Arenaria saxosa* of New Mexico and *Corydalis Caseana* of the Sierra Nevada. To find these plants growing with species of so northern a habitat as *Calypso borealis*, *Listera cordata*, and *Aspidium Filix-mas* was very interesting. The *Corydalis* prefers the banks of the little mountain-streams and cold springs in the shade of the forests of *Abies Engelmanni* and *grandis*. Here it reaches a height of 5 feet; the finely-dissected leaves are 2 feet and more long, forming a very handsome foliage-plant, but its blue-tinged flowers lack clearness of color.

In the valleys of the Los Pinos, Florida, and Animas, at about 7,000 feet altitude, the first decided change appears in the flora. Plants not before known to exist in Colorado become common, and in some places form the greater part of the vegetation. Bushes of *Fendlera rupicola* 10 feet high grow upon the bluff-sides; thickets of *Peraphyllum ramosissimum* are very plenty, now full of its long-stemmed fruit called by the few white settlers wild crab-apple. Conspicuous among the plants which mark the change in the flora are *Rhamnus Californicus*, *Hosackia*, *Yucca baccata*.

Southwestern Colorado, an extent of country of very different altitudes, and embracing within its limits various conditions of soil, moisture, &c., of course has a varied flora. The flora of the alpine and subalpine regions of the Sierra La Plata, the only high mountains in our district, like that of the Piedra and Los Pinos Mountains, is similar to that of equal altitudes in Northern Colorado.

To the alpine flora, the only addition is a bright-pink clover, named by Mr. Watson *Trifolium Brandegei*. The subalpine flora compared with that of the eastern slope has a greater abundance of *Rubus Nutkanus*, *Pyrus sambucifolia*, *Prosartes trachycarpa*.

The Mesa Verde, a plain of two hundred square miles, raised nearly 1,000 feet above the surrounding country, is a prominent topographical feature of Southwestern Colorado. Its surface is perfectly dry; the showers from the La Plata Mountains rarely wetting it except upon the northern edge. *Juniperus occidentalis* covers almost the whole mesa, and it is to the abundance of this un-

graceful, bushy tree that the name Green Mesa is due. The piñon is scattered here and there, sometimes covering quite an area, especially where the sandstone does not reach the surface. Very rarely, upon a rocky ledge, is seen a solitary tree of *Juniperus Virginiana*. The trails over the Mesa Verde, some of them evidently very old, generally cross the small parks and follow up openings in the juniper-forest. The sage-bush (*Artemisia tridentata*) covers these parks so thickly that they are almost impassable excepting by the narrow trail, so narrow that as we ride along the encroaching *Artemisia* is continually brushing against us. The yellow flowers of *Helianthus petiolaris* and *lenticularis*, of *Actinella Torreyana* and *Richardsonii*, the delicate pink blossoms of *Mamillaria vivipara*, the light blue of *Pentstemon linaroides*, and the hooked spines of *Echinocactus Whipplei* sometimes are seen; but, after having crossed the Mesa Verde, one has the impression that its vegetation is all *juniper* and *sage-brush*. There is a great difference between the vegetation of the northern slope and cañons (altitude 8,000 feet) and that of the southern edge (altitude 6,000 feet), due mainly to the lower altitude and smaller rain-fall of the southern portion. The northern portion is covered with a luxuriant growth of *Peraphyllum*, *Fendlera*, *Purshia tridentata*, *Cercocarpus parvifolius*, *Amelanchier alnifolia*, *Quercus*, and *Yucca baccata*, while the southern portion has only a growth of *Purshia*, *Cowania*, *Ephedra*, and *Fraxinus anomala*.

The valley of the San Juan really comprises the whole extent of country of the southwest explorations; but as the term is applied to the habitat of plants of the collection, it is limited to a district north of the river about twenty miles wide. The San Juan River was followed from the mouth of the Rio La Plata (5,300 feet altitude) in New Mexico, along its course into Utah, twenty miles from the Colorado line (4,300 feet altitude). All plants of the San Juan Valley of New Mexico come into the limits of Colorado about the mouth of the Mancos, where the San Juan barely touches the corner of Colorado. Some of the species seen only in Utah may not enter the limits of Colorado; but their number is small, less than a dozen. The San Juan Valley is even drier than the Mesa Verde; the soil is perfectly dry close up to the water of the river. The bottom-lands are generally less than one mile wide, and produce quite a growth of plants, which send their roots down in the earth to the level of the water of the river. The course of the Rio San Juan can be distinctly seen long before we reach its banks; it is a line of green a mile wide and many miles in length, winding through the gray desert. Groves of large cottonwood are scattered along its course, and dense thickets of *Shepherdia argentea*, *Cratægus cocciena*, and *Salix longifolia* line its banks. The fragrance of the Bigelovias and other plants is noticeable at a distance of two or three miles; and as we return in the evening after a ride over the dry, barren plains, the delightful odor filling the air announces the proximity of the river long before we reach it. The mesas of the San Juan Valley are very barren of vegetation. The handsome *Eriocoma cuspidata* is sometimes plenty enough to afford a night's pasturage for the mules, and, compared with the general scarcity of growth, *Pleuraphis Jamesii* often seems plenty. There are large areas with absolutely nothing growing upon them, and often, even along the streams, our day's journey would be lengthened four or five miles before grass could be found sufficient for a camping-place. The alkaline flats abound in *Chenopodiaceæ*, mainly *Sarcobatus*, *Atriplex Nuttallii* and *confertifolia*.

Where Mount Elmo and Montezuma Creeks, dry streams from the north, come down to the San Juan, we find many interesting plants.

Symmetrical clumps of *Calamagrostis longifolia* 6 feet high, their large panicles bending gracefully outward, send their roots deep down into the dry sand.

Rings of *Muhlenbergia pungens* are scattered over the flats here and there. This grass spreads by underground stems, which grow continually outward, the older inner part dying and disappearing, leaving the bare sand surrounded by a circumference of living green. These centrifugal circles are sometimes 10 feet in diameter, with the interlaced purple panicles of the ring a foot wide. The rare *Oxytenia acerosa*, with *Bigelovia Wrightii*, *Heliotropium convolvulaceum*, *Dicoria Brandegei*, *Andropogon Torreyana*, are some of the plants common in these dry rivers. When we ride up these rivers of sand, sometimes a bright, green *cottonwood*, or *Negundo*, is met with, showing that water must be down deep somewhere. How they managed to exist before their roots reached moisture is an interesting question. El Late and Cariso, groups of low mountains about 9,000 feet in altitude, produce a flora similar to one another and very different from that of the plains from which they rise. *Pinus edulis* and *Juniperus occidentalis* cover Cariso, and grow nearly upon the summit of El Late. The characteristic vegetation is the same as that of the La Plata and Animas of the same altitude.

Upon the eastern slope of the Rocky Mountains, in the valley of the Arkansas, the *Cactaceæ*, on account of their abundance and size, are a prominent part of the vegetation. It was expected that the southern latitude, low altitude, and dryness of Southwestern Colorado, with its proximity to the cactus region of Arizona, would be favorable to the growth of *Cactaceæ*, but the number of species is less than in the Arkansas Valley, and the number of plants is very small. Only two species to be added to the flora of Colorado make their appearance: an *Echinocactus* and a *Cylindropuntia*. The *Cylindropuntia* is found at altitudes between 7,000 and 8,000 feet, and *Echinocactus Whipplei* generally does not grow in the lowest altitudes, so that the country along the San Juan River has not a single additional species of cactus, and lacks very nearly all the species of the eastern slope. The great beds of *Opuntia Missouriensis* which cover the plains and parks of the eastern slope are not found in Southwestern Colorado; neither *Opuntia arborescens* nor *Cereus viridiflorus* was seen, and no species is common.

The genus *Astragalus* is represented by few species, and these are not very abundant. They grow almost wholly above 6,000 feet altitude. None of the species of *Astragalus* of Southwestern Colorado, with the exception of *A. lonchocarpus*, appear upon the eastern slope. Twelve leguminous plants were found which grow in Eastern Colorado, while not more than eight species common to the plains of both eastern and western slopes were seen. Few of the *Leguminosæ* are very abundant.

The shrubby *Rosaceæ* are in strong force and characteristic of the flora of Southwestern Colorado from high to low altitudes. The species common to both eastern and western slopes, the abundance of some which rarely grow upon the eastern slope, together with those species which here enter the limits of Colorado, give great prominence to the rosaceous shrubs.

The genus *Eriogonum* is well represented in species, and the plants are very abundant, especially those of the annuals. Nine annual species grow in the San Juan Valley; in the Arkansas Valley but three are found, and in Northern Colorado but one.

At about 8,000 feet altitude, the common oak of Colorado is very abundant, growing upon the bluff-sides and becoming a small tree in moist locations. At lower altitudes, it is rarely seen, and is a small bush

about two feet high, with small, somewhat sharply-lobed, leaves. The forms so common in the Greenhorn range, bearing small, nearly evergreen leaves, do not grow in Southwestern Colorado.

The subalpine *Coniferæ* of the southwestern slope are mainly *Abies Engelmanni* and *grandis*. These two species, either together or in forests of one alone, cover the western slope down to the altitude of *Pinus ponderosa*, 9,000 feet. Both species become large, magnificent trees. *Abies Engelmanni* is the only conifer found at timber-line, but *A. grandis* reaches very nearly to as high an altitude. *Abies Menziesii* is confined mainly to the vicinity of the water-courses between altitudes of 10,000 and 8,000 feet *Abies Douglasii* is not very common, and grows between altitudes of 9,000 and 7,000 feet, descending into the region of *Pinus edulis* and *Juniperus occidentalis*. *Abies concolor* was not seen upon the western slope, and not a tree of *A. grandis* could be found upon the eastern slope. The range of *Abies concolor* in Colorado is southward from the Ute Pass and Manitou (6,000 to 7,000 feet altitude); in the cañons of the Greenhorn range, to the summit of Lucille Hill, Rosita, 1,000 feet, along the Sangre de Cristo and Raton Mountains to New Mexico. *Pinus ponderosa* in Southwestern Colorado is abundant at 8,000 feet altitude, and its large trees will furnish a great amount of lumber. *Pinus flexilis* is not common; it grows at an altitude of 8,500 feet with *Pinus ponderosa*, *Abies grandis*, *Menziesii*, *Engelmanni*, and *Douglasii*, all associated at this altitude. *Pinus edulis* and *Juniperus occidentalis* cover the mesas and mountains below 7,500 feet altitude. The piñon often grows in company with *Pinus ponderosa* and *Abies Douglasii*, and in the Arkansas Valley grows above the lower altitudes of *Abies concolor* and *Menziesii*. Last year *Juniperus occidentalis* and *Virginiana*, *Abies concolor*, and *Pinus ponderosa* matured quantities of fruit, and probably the other *Coniferæ* also did; but this year, wishing to collect seeds, I was unable to find any, and am sure that the *Coniferæ* of Southern Colorado matured no fruit. *Pinus edulis* is said to fruit once in seven years, and it certainly sometimes fruits in such abundance that the nuts are collected by the Mexicans in quantity.

Southwestern Colorado having never been the residence of the white man, those plants which become introduced with eastern seeds have not yet made their appearance. *Xanthium strumarium* has been probably introduced upon both eastern and western slopes. Upon the eastern slope it is said to have come from Texas with the importation of cattle, the burrs clinging to their hair and becoming everywhere distributed. Upon the western slope it perhaps was introduced from the south by the cattle, sheep, and goats of the Indians. It is not as common as upon the eastern slope, but will become so when farmers, like those of the eastern slope, begin to irrigate the land. *Xanthium* must have a location where its roots can reach wet ground, and prefers the banks of irrigation-ditches, where, in company with other troublesome plants, it is permitted to grow to perfection, and its seeds spread over the cultivated fields. The corn-fields of the band of Utes about El Late are not irrigated and are free from introduced weeds, having very few of any sort. The corn is planted in hills without any regularity; the roots striking down to moisture soon, they are but slightly dependent upon showers from El Late. The most noticeable plants growing among the corn were *Nicotiana attenuata* and *Convolvulus sepium*. The edges of the field produced a fine growth of those species of *Helianthus* which so rapidly increase in number with the irrigation and cultivation of the soil. *Helianthus petiolaris* and *lenticularis* are now sparingly found in Southwestern

Colorado, but, when the valleys of the streams are cultivated, will become as plenty and as troublesome as upon the eastern slope. The vegetation of the valleys of Southwestern Colorado was free from the effects of irrigation, cultivation, and large herds of cattle and sheep, all of which rapidly produce great changes.

As before mentioned, the flora of Southern and Southwestern Colorado above timber-line is nearly the same as the alpine floras of Central and Northern Colorado. From timber-line (11,000 to 12,000 feet altitude) down to 8,000 feet altitude, the effects of latitude and longitude are barely noticeable upon the flora. As we approach New Mexico, but very few plants of a more southern habitat appear, and very few of those common in Northern Colorado are absent. The western slope produces very few plants of a more western habitat until altitudes below 8,000 feet have been reached. Below this altitude are found the somewhat distinct floras of the different parts of Colorado. The flora below 8,000 feet, north of the divide between the Platte and Arkansas Rivers, is in greater part found southward in the parks and valleys along the base of the mountains. It contains the greater number of species of *Astragalus*, thirty species growing, where, upon an equal area southward and westward, not more than half a dozen can be found. As we cross the divide and come into the valley of the Arkansas, a difference in the aspect of the vegetation is at once noticed. This is the cactus-center of Colorado. *Mentzelia* is magnificently represented by seven species. The *Nyctaginaceæ* are nearly as well developed as in Southwestern Colorado, while *Solanaceæ* and *Euphorbiaceæ* are much better represented. Many plants of southern habitat, as *Zinnia*, *Melampodium*, *Ximenesia*, *Tricuspis*, &c., become quite conspicuous, and many stragglers of the south here grow in their most northern location. San Luis Valley, an elevated plain (7,000 to 9,000 feet altitude), does not possess the different conditions necessary to the growth of an extensive flora. The alkaline flats produce an abundance of *Chenopodiaceæ*.

Many interesting plants undoubtedly grow along the boundaries of the park and the edges of the mountains. Its southern portion on the Rio Grande (altitude 7,000) has, in a very limited degree, the appearance of a New Mexican flora. The number of the phænogamous plants growing in Southwestern Colorado will not equal the 900 species that can be found upon any similar area upon the eastern slope. The impressions received by any one who has noticed the flora of the eastern slope, riding rapidly over Southwestern Colorado, below 8,000 feet altitude, are, the great scarcity of all vegetation; the comparative abundance of rosaceous shrubs, and *Artemisia tridentata*; the great number of the annual species of *Eriogonum*; the showy blossoms of *Malvaceæ*; the few species of *Astragalus* and *Pentstemon*.

LIST OF PLANTS OF COLORADO NOT MENTIONED IN THE SYNOPSIS OF THE FLORA OF COLORADO, MISCELLANEOUS PUBLICATIONS, No. 4.

Thanks are due to Dr. Asa Gray for descriptions of new species and determinations of many plants of the collection; to Dr. George Engelmann for his descriptions of new species and determinations of *Cactaceæ*, *Loranthaceæ*, and species of other orders; to Mr. S. Watson for determinations; to Prof. Thomas C. Porter for determinations of plants from the vicinity of Cañon City; and to Prof. D. C. Eaton for herbarium facilities and assistance; to Mr. Eugene A. Rau for the list of *Musci* and *Hepaticæ*; and to Mr. J. H. Redfield for much assistance.

RANUNCULUS RHOMBOIDEUS, Goldie.
Sierra La Plata, 10,000 feet altitude.

BERBERIS FENDLERI, Gray, Plant. Fendl., p. 5.
Valleys of the Rio Grande, Animas, and Mancos.

CORYDALIS CASEANA, Gray, Proc. Am. Ac., x, 69.
Piedra Mountains, 10,000 feet altitude.

NASTURTIUM TRACHYCARPUM, new species.
E radice annua? erectum (pedale), ramosum, fere glabrum; foliis lyrato-sub-pinnatifidis; racemis laxis; floribus albidis; petalis spathulatis sepala antherasque oblongo-sagittatas parvum superantibus; siliquis oblongo-linearibus (lin. 4–5 longis) papilloso-asperatis in pedicello rigido mox recurvato adscentibus stylo longo subulato superatis.
The rhachis and stout pedicels are studded with the small and rough papillæ which abound on the pod, and suggest the name of this very distinct species.—ASA GRAY. Southwestern Colorado.

STREPTANTHUS CORDATUS, Nutt.
Mesa Verde, growing under *Juniperus occidentalis*, 6,500 feet.

THELYPODIUM INTEGRIFOLIUM, Endl. var.?
Flowers white; racemes much longer and pod more stipitate. Common in the San Juan Valley.

DRABA AUREA, var. *stylosa*, Gray.
Wagonwheel Gap, on the Rio Grande.

BRASSICA.
San Juan Pass, 10,000 feet, introduced.

BISCUTILLA (DITHYREA) WISLIZENI, Englm.
Valley of the San Juan, 4,500 to 6,000 feet altitude.

CLEOME AUREA, Nutt.
Valleys of the San Juan and Mancos, 5,500 feet altitude.

CLEOME SONORÆ, Gray, Pl. Wright, p. 16.
San Luis Valley.

CLEOMELLA OÖCARPA, Gray, new species, Proc. Am. Acad., xi, 72.
Diffusa, spithamæa ad sub-pedalem; foliolis oblongo-linearibus; racemo sæpissime densifloro; bracteis inferioribus foliis conformibus, superioribus simplicibus; setulis stipularibus manifestis; staminibus petala superantibus; ovario apice 3-ovulato; capsula ovata lineam longa stylo breviusculo superata stipite (pedicellum subæquante) triplo breviore; seminibus 1–2 lævibus.
Very abundant on the adobe hillsides and alkaline flats on the borders of the Mesa Verde about the Rio Mancos. Collected also in Nevada by Drs. Torrey and Gray.

SILENE ANTIRRHINA, L.
Mountains about Cañon City, 6,000 feet altitude.

ARENARIA SAXOSA, Gray, Pl. Fendl., p. 13.
Piedra and Los Pinos Mountains, 10,000 feet; Parrott City and banks of the La Plata to 6,000 feet altitude.

PORTULACA RETUSA, Englm., Pl. Lindn., 2, p. 154.
Arkansas Valley and Southwestern Colorado.

MALVASTRUM LEPTOPHYLLUM, Gray, Pl. Wright, p. 17.
Valleys of the San Juan and La Plata.

SPHÆRALCEA EMORYI, Torrey, Pl. Wright, 1, 21.
Valleys of the San Juan, La Plata, and Mancos.

THAMNOSMA TEXANUM, Gray.
Soda Spring Ledge, Cañon City, 5,400 feet altitude.

GLOSSOPETALON SPINESCENS, Gray, Pl. Wright, ii, 29.
Near Hovenweep Castle, 5,250 feet altitude.

RHAMNUS (FRANGULA) CALIFORNICUS, Esch.
Valley of the Animas, 6,500 feet altitude.

POLYGALA ACANTHOCLADA, Gray, new species, Proc. Am. Acad., xi, p. 73.
Fruticulosa, bipedalis, ramosissima, subcinereo-pubescens, spinis gracilibus armata; foliis lineari-spathulatis rigidulis (lin. 3–4 longis); floribus subaxillaribus sparsis albidis lin. 2 longis pedicello basi bibracteato parum brevioribus; alis obovatis sepalis cæteris duplo majoribus corollam adæquantibus; carina breviter cymbiformi nuda dorso umbonata.
Growing upon a bluff side near the San Juan River in Utah, not far from the Colorado boundary.

LUPINUS SILERI, Watson.
Trail between Parrott City and the Mancos, 7,500 feet altitude.

LUPINUS SITGREAVII, Watson, Proc. Am. Ac., viii, 527.
Common in Southwestern Colorado, 7,000 feet altitude.

TRIFOLIUM ERIOCEPHALUM, Nutt.
Lost Cañon and Parrott City, 8,600 feet altitude.

TRIFOLIUM BRANDEGEI, Watson, new species, Proc. Am. Ac., xi, p. 130.
Dwarf, perennial, cespitose, and acaulescent, glabrous, the inflorescence slightly villous; stipules scarious; leaflets elliptic-oblong, thin, acutish, entire, a half to an inch long; peduncles about equaling the leaves; flowers spicate in a loose naked head, purplish, seven lines long; calyx-teeth lanceolate, acuminate, a little longer than the campanulate tube; ovary stipitate, 7-ovuled.
A very showy species, common in the Sierra La Plata.

HÒSACKIA WRIGHTII, Gray, Plant. Wright, p. 42.
Southwestern Colorado, 8,000 feet altitude.

DALEA LANATA, Spreng.
Valley of the San Juan, 6,000 to 4,000 feet.

PETERIA SCOPARIA, Gray, Pl. Wright, p. 50.
La Plata Valley.

ASTRAGALUS DIPHYSUS, Gray.
Southwestern Colorado, 6,000 feet.

ASTRAGALUS BIGELOVII, Gray.
Valley of the Mancos, 5,000 to 6,000 feet.

ASTRAGALUS SUBCOMPRESSUS, new species.
A. racemoso sect. *Galegiformium* admodum similis; dentibus calycis brevioribus; corolla ochroleuca; legumine falcato lateraliter compresso

intus septo completo bilocellato, sulco dorsali angusto subclauso, stipite e calycis tubo haud exserto.

Legumes an inch and a quarter or shorter in length, 2½ to 3 lines wide, the well-developed ones decidedly falcate; the partition about twice the length of the depth of the groove, which in the cross-section before dehiscence is oval and almost closed.—ASA GRAY.

Animas Valley, 7,000 feet altitude.

ASTRAGALUS ROBBINSII, Gray, var. (?) *occidentalis*, Watson.

Animas Valley, 9,000 feet.

ASTRAGALUS HUMILLIMUS, new species.

Cæspitoso-depressus, condensatus; caudice lignescente; caulibus vix pollicaribus stipulis scariosis coalitis imbricato-tectis, petiolis persistentibus hystricosis; foliolis 3–5 jugis oblongis canescentibus margine revolutis (lineam longis) demum deciduis; pedunculis brevibus 1–3 floris; calycis dentibus subulatis tubo oblongo-campanulato dimidio brevioribus; corolla pallida; legumine ovato-coriaceo albo-pubescente parvo (lin. 2 longo) uniloculari 9-ovulato fere monospermo, suturis extus prominulis.

Habit of *A. jejunus*, Watson, but much more dwarf and condensed; petioles and rhachis more spinescent and persistent; pod decidedly different.—ASA GRAY.

Growing upon sandstone-rock of the Mesa Verde, near the edge of the Mancos Cañon.

ASTRAGALUS HAYDENIANUS, new species.

A. bisulcato affinis, minor, pube magis cinerea; spica elongata virgata; floribus multo minoribus (lin. 3–4 longis); calycis dentibus subulatis tubo multo brevioribus; corolla alba, carina tantum apice purpureo-tincta; legumine ovali utrinque obtusissimo venis transversis ruguloso 6–7-ovulato 2–4-spermo, facie ventrali late profundeque impressa sutura costæformi valde prominente percussa, stipite calycem haud superante.

Also collected on Grand River, Middle Park, by H. N. Patterson. A striking species, with slender stems 2 or 3 feet high; dedicated to the director of the Survey, and one of the oldest, most indefatigable, and distinguished explorers of the whole Rocky Mountain region.—ASA GRAY.

The flowers of this species have the peculiar disagreeable odor of those of *A. bisulcatus*.

Southwestern Colorado, between Parrott City and the Mancos, 8,000 feet.

ASTRAGALUS PATTERSONI, new species.

Scytocarpi, robustus, 1–2-pedalis, adpresso-puberulus, nunc glabellus; foliolis 5–10-jugis oblongis crassiusculis (semipoll. ad pollicem longis); pedunculis racemoso-plurifloris folium æquantibus vel superantibus; floribus ultra semipollicaribus mox pendulis; calycis dentibus setaceo-subulatis tubo cylindraceo dimidio brevioribus; corolla alba, carina apice nunc purpurascente; legumine ovali crasso-coriaceo inflato glabro (sæpius pollicari) polyspermo, basi intra calycem abrupte contracta substipitiformi, suturis nec intrusis nec extus prominulis.

The only flowering specimens seen were collected by Mr. H. N. Patterson, for whom it is named, in the foot-hills of Gore Mountains, Colorado.

Fruiting specimens were also abundantly collected by L. H. Ward in Powell's exploration.—ASA GRAY.

Fruiting specimens only; collected in McElmo Valley, 5,500 feet altitude.

ASTRAGALUS ———.

An interesting species, collected in fruiting specimens only, grows about Navajo Springs, near Cariso Mountains, Arizona. Another uncertain species, growing upon the alkaline flats of the La Plata, was almost out of fruit in June.

OXYTROPIS PODOCARPA, Gray.

Sierra Sangre de Cristo, 12,000 feet altitude, and alpine summits of the mountains near Breckenridge.

PRUNUS DEMISSA, Walp.

Common upon both eastern and western slopes at 8,000 feet elevation.

COWANIA MEXICANA, Don.

Mesa Verde and its cañons; El Late, 6,000 feet.

COLEOGYNE RAMOSISSIMA, Nutt.

Near Hovenweep Castle, 5,250 feet altitude.

PERAPHYLLUM RAMOSISSIMUM, Nutt.

Valleys of the Animas, La Plata, and Mancos, 6,000 to 8,000 feet altitude.

CRATÆGUS COCCINEA, L.

Greenhorn Range of the Arkansas Valley and along the banks of all the streams and rivers of Southwestern Colorado.

CRATÆGUS RIVULARIS, Nutt (?).

Texas Creek, near the Sangre de Cristo, 8,000 feet.

POTENTILLA CRINITA, Gray, Pl. Fend., 41.

Thompson's Park, 7,500 feet.

HEUCHERA RUBESCENS, Torr.

El Late, 9,000 feet.

FENDLERA RUPICOLA, Eng. & Gray, Pl. Wright, 77.

Valleys of the Animas, La Plata, and Mancos, Mesa Verde and Cariso Mountains.

TILLAEA DÆRUMMONDII, T. & G.

Rio Grande Valley.

CALLITRICHE VERNA, L.

Rio Grande Valley.

ŒNOTHERA BREVIPES, Gray, var. *parviflora*, Watson.

Sand-bar of the Rio Mancos, 5,000 feet.

ŒNOTHERA SCAPOIDEA, Nutt.

Alkaline flats, Cañon City Park, 5,500 feet.

MENTZELIA ORNATA, T. & G.

Common throughout the Arkansas Valley, from 4,000 to 6,000 feet altitude. The flowers are more than 6 inches in diameter, opening at twilight, about two hours later than those of *M. nuda*. When opening, they fill the surrounding air for some distance with fragrance. *M. multiflora*

also gives out the same delicious odor when the flowers at first open. It is often noticeable 100 feet from the plants.

MENTZELIA CHRYSANTHA, new species.

Biennis, ramosissima, caule albido asperuto; foliis ovato-lanceolatis sinuato-dentatis, inferioribus versus basin angustatis, superioribus sæpius basi lata sessilibus; floribus subsessilibus bractealatis oppositifoliis; pomeridianis aureis, calycis laciniis lanceolato-subulatis tubo longioribus; petalis sub-10 lanceolatis acutis longe unguiculatis interioribus in stamina latiora abeuntibus; capsula cylindrica seu ovata; seminibus ovatis compressis anguste marginatis nec alatis.

Barren clayey limestone hills on the Arkansas, near Cañon City, with *Frankenia*, several shrubby *Atriplex*, *Juniperus occidentalis*, etc., where I discovered it in September, 1874; also in Southern Utah, Dr. Parry, 1874, No. 78, doubtfully referred to *M. multiflora*.

From the large, fleshy, branching, not fusiform root rise branching stems 1–2 feet high; leaves 1–3 inches long, ¼–1½ inches wide, more or less coarsely dentate, upper ones often entire; flowers 15–20 lines in diameter, open in the afternoon (and evening ?); petals 6–9 lines long, 2–3 lines wide, often less than 10 in number, the innermost smaller and antheriferous; ovary with three placentæ, each bearing two series of ovules; capsule 3 lines wide, in some ½, in others fully 1 inch long; seeds very narrowly margined, similar to those of *M. lævicaulis*, but much smaller and not winged, surface facetted. Apparently near *M. pumila*, as described in Torr. & Gr. Fl. N. A., 1, 535, but that species is said to have small terminal flowers and winged seeds. Name from the golden-yellow color of the flowers, by which it is easily distinguished from the different cream-white species which grow in the same region. This color, however, gradually fades in drying, or becomes brown; this is also the case in the yellow flowers of *M. lævicaulis*, while the flowers of *M. oligosperma* retain their color much better.—GEO. ENGELMANN.

ECHINOCACTUS WHIPPLEI, E. & B.

La Plata Valley and mesa Verde, 5,000 to 8,000 feet.

CEREUS CÆSPITOSUS; Eng., var. *castaneus*, Eng.

South of Pueblo, mesas of the Saint Charles.

OPUNTIA (CYLINDRO-PUNTIA)———?

Spreading over the ground; sometimes the small joints ascending to a height of 1 foot; flowers small, yellow; fruit yellow and unarmed. In flower about the 1st of July. Not determinable on account of the lack of mature seeds. La Plata Valley, Mancos, and McElmo, 6,500 feet.

ARALIA NUDICAULIS, L.

Ute Pass and Greenhorn Range.

SYMPHORICARPUS OREOPHILUS, Gray.

Mountains near Cañon City.

GALIUM ANGUSTIFOLIUM, Nutt.

Mancos Cañon and Cariso, 5,500 feet.

GALIUM BRANDEGEI, new species.

Cæspitoso-depressum, parvum, glabrum; radicibus fibrosis; foliis quarternis obovatis vel spathulatis fere eveniis, lin. 1–3 longis; pedunculis unifloris solitariis geministe nudis; flore albido semilineam longo; fructu lævi glabro.

A diminutive species, hardly to be compared with any other of this country.—ASA GRAY.

Near the banks of the Rio Grande, where the Los Pinos trail begins to ascend the Sierra Madre. September.

BRICKELLIA LINIFOLIA, D. C. Eaton, King's Rep., p. 137.

Common in Southwestern Colorado.

BRICKELLIA MICROPHYLLA, var. *scabra*, Gray, Proc. Am. Ac., xi, 74.

Foliis parvulis rigidioribus papilloso- vel hirtello-scabris; pappo tantum 16–20-chæto.

Very common upon the sandstone-rocks of the Mesa Verde. Also collected by Dr. Parry.

ASTER NOVÆ-ANGLIÆ, L.

Cañon City.

ASTER PAUCIFLORUS, Nutt.

Growing about a warm soda-spring in the Animas Valley. In this species, the pappus separates readily from the achenium, with the bristles slightly connected at their base.

ASTER COLORADOENSIS, Gray, new species, Proc. Am. Acad., xi, 76.

MACHÆRANTHERA sed perennis, nanus, tomentuloso-canescens; caulibus in caudice lignescente confertis plurimis monocephalis; foliis imis spathulatis, summis fere linearibus, omnibus argute dentatis, dentibus spinuloso-setiferis; involucri hemisphærici squamis pluriserialibus subulatis laxiusculis; ligulis 35–40-linearibus purpureis elongatis; acheniis brevibus turbinatis creberrime cano-villosis.

Found in the mountains of Northern Colorado by nearly all collectors, and passed over as a form of a species of *Machæranthera*.

Southwestern Colorado, San Juan Pass, 12,000 feet altitude.

ERIGERON STENOPHYLLUM, var. *tetrapleurum*, Gray.

In rocky localities of the Mancos Cañon and Mesa Verde, 5,500 feet.

ERIGERON FLAGELLARE, Gray.

Cañon City and Southwestern Colorado.

ERIGERON BIGELOVII, Gray, Bot. Mex. Bound., 78.

Flats of the San Juan Valley, 5,200 feet.

TOWNSENDIA FENDLERI, Gray.

Wet Mountain Valley and Huerfano Creek.

TOWNSENDIA INCANA, Nutt.

Mesas of Southwestern Colorado.

TOWNSENDIA STRIGOSA, Nutt.

Flats of the San Juan Valley, 5,000 feet.

BIGELOVIA WRIGHTII, Gray.

San Juan Valley, 5,000 to 4,000 feet.

GRINDELIA MICROCEPHALA, DC.

Mancos Valley, 7,500 feet altitude.

APLOPAPPUS NUTTALLII, T. & G.

Mesas near Rio Mancos, 7,000 feet altitude.

APLOPAPPUS LANCEOLATUS, T. & G.

Near lake of San Luis Valley.

APLOPAPPUS ARMERIOIDES, Nutt.
Mesas of Southwestern Colorado, 7,000 feet.

APLOPAPPUS GRACILIS, Gray, Plant. Fend., 76.
Mancos Plains, 7,500 feet altitude.

BACCHARIS WRIGHTII, Gray, Plant. Wright, 101.
Soda Spring Ledge, Cañon City.

DICORIA BRANDEGEI, Gray, Proc. Am. Ac., xi, 76, new species.
Diffusa, pube substrigulosa cinerea; foliis lanceolatis obtusis subintegerrimis; capitulis laxe racemoso-paniculatis parvis; involucri squama interna florem fœmineum fulcrante unica cæteris haud longiore achenio oblongo turgido margine calloso-dentato subdimidio breviore.
An interesting accession to the genus, requiring considerable modification of the character.
Common along the San Juan, between McElmo and Recapture Creeks.

OXYTENIA ACEROSA, Nutt., Pl. Gambell, 172.
Very abundant in the dry gulches running into the San Juan at about 4,500 feet altitude.

ENCELIA FRUTESCENS, Gray, Proc. Am. Ac., viii, 657.
Rocky edges of mesas, Southwestern Colorado.

ENCELIA MICROCEPHALA, Gray, Proc. Am. Ac., viii, 657.
San Juan Valley, 4,500 feet.

HYMENANTHERUM (LOWELLIA) AUREUM, Gray, Plant. Fend., 89.
Cañon City, Colorado Springs, Pueblo, and on the Huerfano.

WYETHIA SCABRA, Hook., Proc. Am. Ac., viii, 655.
La Plata Valley, 5,000 feet; base of Cariso.

WYETHIA ANGUSTIFOLIA, Nutt.
Valley of Los Pinos Creek, 8,000 feet.

BALSAMORHIZA SAGITTATA, Nutt.
Mesas of La Plata and Los Pinos Creeks, 8,000 feet.

ACTINELLA TORREYANA, Gray.
Mesas of Southwestern Colorado—common.

HYMENOPAPPUS FLAVESCENS, Gray, Plant. Fend., 97.
San Juan Valley, 4,500 feet altitude.

HYMENOPAPPUS LUTEUS, Nutt.
San Luis Valley.

SCHKUHRIA INTEGRIFOLIA, var. *oblongifolia*, Gray, Proc. Am. Ac., ix, 199.
Hovenweep, McElmo—common—4,500 to 6,000 feet.

SCHKUHRIA NEO-MEXICANA, Gray, Pl. Fend., 96.
Rio Grande Valley, near Del Norte—plants small, not 2 inches high.

ARTEMISIA BIENNIS, Willd.
Near Cañon City and Parrott City.

ARTEMISIA BIGELOVII, Gray.
Abundant in the Arkansas Valley.

ANAPHALIS MARGARITACEA, R. Br.
La Plata Valley, near Parrott City.

GNAPHALIUM PALUSTRE, Nutt.
Parrott City and San Luis Valley.

MADIA GLOMERATA, Hook., Proc. Am. Ac., ix, 189.
Near Parrott City, 8,700 feet.

CNICUS PARRYI, Gray, Proc. Am. Acad., x, 47.
Parrott City, 8,400 feet.

STEPHANOMERIA EXIGUA, Nutt.
San Juan Valley, 5,000 feet altitude.

LACTUCA CANADENSIS, L.
Greenhorn range and mountains near Canon City.

PLANTAGO MAJOR, L.
Sandflats of the Mancos and Dolores, 7,000 feet—apparently indigenous.

PENTSTEMON BARBATUS, Nutt, var. *trichander*, Gray, Proc. Am. Acad., xi, 94.
Humilior e caudice lignescente; antheris longe parceque lanoso-barbatis!
A new variety of this handsome *Pentstemon*—Southwestern Colorado.

PENTSTEMON LINARIOIDES, Gray.
Southwestern Colorado, 6,000 to 7,000 feet.

PENTSTEMON BRIDGESII, Gray, Proc. Am. Ac., vii, 379.
El Late, 6,000 to 8,000 feet altitude.

ORTHOCARPUS PURPUREO-ALBUS, Gray.
Valleys of the La Plata and Mancos.

CORDYLANTHUS KINGII, Watson, King's Rep., 233.
San Juan Valley, 5,500 feet.

PEDICULARIS———.
A species common upon the Mesa Verde, growing under *Juniperus occidentalis*. Flowers and fruit not seen.

POLIOMINTHA INCANA, Gray, Proc. Am. Ac., 1870, 295.
San Juan Valley, 4,500 feet.

MARTYNIA PROBOSCIDEA, Glox.
Cañon City, 5,300 feet altitude.

ERITRICHIUM CALIFORNICUM, DC.
Rio Grande Valley.

PHACELIA CRENULATA, Torr., Proc. Am. Ac., x, 318.
Rio Mancos, 5,300 feet altitude.

NAMA HISPIDA, Gray.
San Juan Valley, 5,000 feet.

GILIA (IPOMOPSIS) HAYDENI, Gray, new species, Proc. Am. Acad., xi, 85.
Fere glabra, e basi indurata perenni vel bienni paniculato-ramosissima, pedalis; foliis linearibus, imis vix spathulatis parce pinnatilobatis

dentatisve, ramealibus plerisque minimis subulatis integerrimis; paniculis subthyrsoideis floribundis calycibusque parum glandulosis; corolla cæruleo-purpurea gracili infundibulari-tubulosa (ultra, semipollicari), tubo lobis suis ovatis calyceque 3–4-plo longiore; antheris oblongo-sagittatis subsessilibus fauci insertis; ovarii loculis 8–9-ovulatis; seminibus paucis oblongis, tegumento humectato nec spirillifero nec mucilaginoso!

A handsome species common upon the mesas of the Mancos, the western slope of the Mesa Verde, and about El Late, 5,000 to 7,000 feet altitude.

GILIA CONGESTA, Hook., var. *crebrifolia*, Gray.

McElmo Creek, 6,000 feet.

GILIA GUNNISONI, T. & G.

San Juan Valley, common.

GILIA BRANDEGEI, Gray, new species, Proc. Am. Acad., xi., 85.

EUGILIA, perennis, pube glandulosa fragrante viscosissima; caulibus erectis spithamæis vel subpedalibus thyrsifloris; foliis circumscriptione linearibus pinnatisectis, segmentis plurimis sessilibus parvis aut oblongo-linearibus rarius ovalibus integerrimis aut bipartitis verticillos 3–4-foliolatos simulantibus; corolla aurea infundibuliformi-tubulosa calyce cylindraceo semiquinquefido 2–3-plo longiore, fauce parum ampliata, lobis ovalibus brevibus; ovulis in loculis paucis.

A showy species, very common at Wagonwheel Gap on the Rio Grande, and also seen near the base of the Sierra Madre on the Los Pinos trail, eastern slope.

DATURA METELOIDES, DC.

Hovenweep Cañon, 5 miles above Hovenweep Castle. The large white flowers seemed wonderfully beautiful contrasted with the surrounding "greasewood and sage-brush".

LYCIUM PALLIDUM, Miers.

San Juan Valley—common.

CUSCUTA UMBELLATA, Kunth.

Hovenweep Cañon—parasitic upon *Portulaca retusa*.

ERYTHRÆA CHIRONIOIDES, Torrey.

Base of Cariso, Arizona.

FRASERA ALBOMARGINATA, Watson, King's Rep., 280.

Mesa Verde and San Juan Valley, 6,000 to 4,500 feet.

FRAXINUS ANOMALA, Torrey.

Mesa Verde, 5,700 feet; Hovenweep, 5,200 feet.

FORESTIERA ACUMINATA, Poir.

Banks of the San Juan.

ATRIPLEX POWELLII, Watson, Proc. Am. Ac., ix, 114.

Alkaline flats of the San Juan and Mancos.

ATRIPLEX NUTTALLII, Watson.

Southwestern Colorado.

ATRIPLEX CONFERTIFOLIA, Watson.

Cañon City and Southwestern Colorado.

GRAYIA BRANDEGEI, Gray, new species, Proc. Am. Acad., xi, 101.
Inermis, sesquipedalis, leviter furfuraceo-cinerea; foliis spathulato-linearibus; thecis minoribus flavidulis oblato-orbiculatis quandoque trialatis basi latissime retusis, alis subundulatis; ovario basilari papuloso.
Found only at the most western topographical station, San Juan Valley, 3,200 feet.

ALTERNANTHERA LANUGINOSA, Torrey.
Pueblo and San Juan Valley.

AMBLOGYNE TORREYI, Gray, Proc. Am. Acad., 5, 169.
Cañon City.

ASCLEPIAS INCARNATA, L.
Cañon City.

POLYGONUM CONVOLVULUS, L.
Colorado Springs—introduced.

POLYGONUM HARTWRIGHTII, Gray, Proc. Am. Acad., 1870, 249.
Cañon City.

POLYGONUM COARCTATUM, Dougl.
Parrott City.

ERIOGONUM INFLATUM, Torrey.
San Juan Valley—common.

ERIOGONUM SALSUGINOSUM, Hook.
San Juan Valley—common.

ERIOGONUM DIVARICATUM, Hook.
San Juan and Mancos Valleys.

ERIOGONUM THOMASII, Torrey.
Southwestern Colorado.

ERIOGONUM RENIFORME, Torrey.
Southwestern Colorado.

ERIOGONUM ACAULE, Nutt.
San Juan Valley.

ERIOGONUM RACEMOSUM, Nutt.
Common at 8,000 feet in Southwestern Colorado.

ERIOGONUM CORYMBOSUM, Benth.
Slopes of the Mesa Verde.

ERIOGONUM CORYMBOSUM, var. *divaricatum*, T. & G.
Slopes of the Mesa Verde.

ERIOGONUM MICROTHECUM, Nutt., var. *confertifolium*, Benth.
Southwestern Colorado.

ERIOGONUM MICROTHECUM, var. *leptophyllum*, T. & G.
Southwestern Colorado—common.

ARCEUTHOBIUM DIVARICATUM, Englm.
Cariso and Mancos Mesas, 6,000 feet—parasitic upon *Pinus edulis*.

PHORADENDRON JUNIPERINUM, Englm.

Cariso Mountains—parasitic upon *Juniperus occidentalis*—6,000 feet altitude.

EUPHORBIA DENTATA, Mx.

Cañon City.

EUPHORBIA SERPYLLIFOLIA, Pers.

Wet Mountain Valley.

EUPHORBIA STICTOSPORA, Engelm. in Bot. Mx. Bound., p. 187; Boiss. in DC. Prod., 15, 2, p. 41.

Abundant on the saline flats about Cañon City (Brandegee).—This common New Mexican species is thus shown to extend into Southern Colorado. It is a prostrate annual, readily known by its pubescence, which extends to the sharp angled capsule. It has rounded, subcordate, sharply serrate leaves; lateral, leafy, crowded racemes, with very small and *slender long-peduncled* involucres and *slender sharply 4-angled rugose-dotted* seeds, which are about as long as the involucre itself (about 0.6 lines long). The styles are short and undivided.—GEO. ENGELMANN.

EUPHORBIA FLAGELLIFORMIS, new species.

Annua, glaberrima; caulibus e basi pluribus ramosissimis declinatis seu decumbentibus; foliis breviter petiolatis e basi subinæquali linearibus subacutis mucronulatis integris; stipulis triangulari-lanceolatis inferioribus connatis superioribus distinctis; involucris solitariis pedicello æquilongo fultis late campanulatis intus hirtulis polyandris, lobis triangularibus glandulas 2–4 parvas concavas angustissime appendiculatas æquantibus; stylis brevibus erectis bifidis; capsula depressa trisulca; seminibus lævibus cinereis trigonis acutis. *E. petaloidea, δ. flagelliformis*, Englm. Bot. Mex. Bound., p. 185. *E. zygophylloides, γ. flagelliformis*, Englm. in Boiss. Euph. DC. Prod., 15, 2, p. 29.

Originally sparingly collected without fruit on the Rio Grande, near El Paso, by Charles Wright.

This species, as it now proves to be, was abundantly seen on the sandy flats of the San Juan River, in Southwestern Colorado, by Mr. Brandegee, where it occurs with the allied *E. petaloidea*, but unfortunately it seemed to be too common to make specimens of!

Stems 6–12 inches long; leaves 6–9 lines long, ½ to 1 line wide; involucres about ¾ line wide; seeds of same length.—Readily distinguished from the allied *E. petaloidea* by the smaller involucre bearing very small and almost naked glands, often less than four in number, the more numerous stamens (often up to 25) with much smaller anthers, and by the smaller, more angular and more pointed, grayish seeds, while those of the allied species are larger, thicker, with rounded angles, and of a more reddish color.—GEO. ENGELMANN.

EPHEDRA ANTISYPHILITICA, C. A. Meyer.

La Plata Valley, 5,500 feet.

EPHEDRA TRIFURCA, Torrey.

Mesa Verde and Animas Valley.

ABIES CONCOLOR, Lindl.

JUNIPERUS OCCIDENTALIS, Hook.

ZANNICHELLIA PALUSTRIS, L.

Cañon City—a very troublesome plant, growing in the irrigation-ditches.

EPIPACTIS GIGANTEA, Dougl.
San Juan Valley.

PROSARTES TRACHYCARPA, Watson, King's Rep., 344.
Sierra Sangre de Cristo and abundant in the La Plata Mountains.

ALLIUM ACUMINATUM, Hook.
La Plata and Animas Valleys, 8,000 feet.

YUCCA BACCATA, Torrey.
Southwestern Colorado—common at 8,000 feet altitude; growing at a higher altitude than *Y. angustifolia.*

FESTUCA TENELLA, Willd.
Cañon City.

STIPA PENNATA, L.
Cañon City.

ORYZOPIS ASPERIFOLIA, Mx.
Piedra Mountains, 9,000 feet.

GLYCERIA NERVATA, Trin.
Wet Mountain Valley.

AIRA FLEXUOSA, L.
Alpine—Sierra Sangre de Cristo.

EATONIA OBTUSATA, Gray.
Near Cañon City.

SETARIA CAUDATA, Roem. & Schultz.
Cañon City.

BOUTELOUA ERIOPODA, Torrey.
San Juan Valley.

BOUTELOUA POLYSTACHYA, Torrey.
San Juan and Mancos Valleys.

MELICA STRICTA, Boland.
Parrott City, 8,500 feet.

ERAGROSTIS POÆOIDES, Beauv., var. *megastachya*, Gray.
Cañon City—introduced.

TRICUSPIS PULCHELLA, Torrey.
San Juan Valley.

CALAMAGROSTIS LANGSDORFFII, Trin.
Parrott City.

ANDROPOGON JAMESII, Torr.
San Juan Valley.

The following is a list of plants seen growing in Southwestern Colorado on the plains of the western slope below an altitude of 8,000 feet. As those of the higher altitudes are generally found throughout the

mountain-regions of the State, they are omitted, as are also those mentioned in the preceding list. It is of interest as a means of comparison with the flora of the eastern slope of the same altitude.

Clematis ligusticifolia, Nutt.
Vesicaria stenophylla, Gray.
Stanleya pinnatifida, Nutt.
Erysimum cheiranthoides, L.
Lepidium alyssoides, Gr.
Cleome integrifolia, T. & G.
Frankenia Jamesii, Torr.
Silene Menziesii, Hook.
Arenaria congesta, Nutt.
Malvastrum coccineum, Gr.
Sphæralcea angustifolia, Spach.
Linum rigidum, Pursh.
Geranium Fremontii, Torr.
Pachystima myrsinites, Raf.
Ceanothus Fendleri, Gr.
Negundo aceroides, Mœnch.
Rhus glabra, L.
Rhus toxicodendron, L.
Trifolium longipes, Nutt.
Psoralea lanceolata, Pursh.
Petalostemon candidus, Mx.
Astragalus lonchocarpus, T. & G.
Glycyrrhiza lepidota, Nutt.
Hedysarum Mackenzii, Richards.
Lathyrus palustris, L.
Spirea dumosa, Nutt.
Rubus Nutkanus, Moç.
Rubus strigosus, Michx.
Purshia tridentata, DC.
Cercocarpus parvifolius, Nutt.
Geum Rossii, Seringe, alpine, flowers double.
Potentilla Anserina, L.
Rosa blanda, Ait.
Pyrus sambucifolia, Cham. & Schlecht.
Amelanchier alnifolia, T. & G.
Philadelphus microphyllus, Gr.
Œnothera biennis, L.
Œnothera albicaulis, Nutt.
Œnothera triloba, Nutt.
Œnothera Hartwegii, Benth., var.
Mentzelia nuda, T. & G.
Mentzelia multiflora, Nutt.
Mamillaria vivipara, Haw.
Echinocactus Simpsoni, Eng.
Cereus Fendleri, Eng.
Cereus phœniceus, Eng.
Opuntia Camanchica, Eng. & Big.
Opuntia Rafinesquii, Eng.
Cucurbita perennis, Gr.
Kuhnia eupatorioides, L., var.
Brickellia California, Gr.
Diplopappus ericoides, T. & G.
Erigeron armeriæfolium, Turcz.
Erigeron Bellidiastrum, Nutt.
Solidago pumila, T. & G.
Bigelovia Howardii, Gr.
Bigelovia Parryi, Gr.
Bigelovia depressa, Gr.
Bigelovia Douglasii, Gr.
Aplopappus spinulosus, DC.
Aplopappus croceus, Gr.
Grindelia squarrosa, Dunal.
Chrysopsis villosa, Nutt.
Iva xanthiifolia, Gr.
Helianthus petiolaris, Nutt.
Helianthus lenticularis, Dougl.
Thelesperma gracile, Gr.
Ximenesia encelioides, Cav.
Gaillardia pinnatifida, Torr.
Actinella scaposa, Nutt.
Actinella Richardsonii, Nutt.
Achillea Millefolium, L.
Artemisia filifolia, Torr.
Artemisia tridentata, Pursh.
Artemisia Ludoviciana, Nutt.
Senecio aureus, L.
Tetradymia canescens, DC., var.
Stephanomeria minor, Nutt.
Pterospora Andromedea, Nutt.
Phelipæa Ludoviciana, Don.
Pentstemon glaber, Pursh.
Castilleia linariæfolia, Benth.
Orthocarpus luteus, Nutt.
Hedeoma Drummondii, Benth.
Monarda fistulosa, L.
Monardella odoratissima, Benth.
Dracocephalum parviflorum, Benth.
Echinospermum deflexum, Lehm., var.
Echinospermum Redowskii, Lehm.
Heliotropium convolvulaceum, Gr.
Collomia longiflora, Gr.
Gilia pungens, Benth.
Calystegia sepium, R. Br.
Saracha Coronopus, Gr.
Nicotiana attenuata, Torr.
Apocynum cannabinum, L.
Asclepias speciosa, Torr.
Mirabilis oxybaphoides, Gr.
Mirabilis multiflora, Gr.
Alliona incarnata, L.
Abronia fragrans, Nutt.

Abronia cycloptera, Gr.
Cycloloma platyphyllum, Moq.
Atriplex patula, L.
Eurotia lanata, Moq.
Sarcobatus vermiculatus, Torr.
Eriogonum alatum, Torr.
Eriogonum Jamesii, Benth.
Eriogonum umbellatum, Torr.
Eriogonum cernuum, Nutt.
Shepherdia argentea, Nutt.
Euphorbia petaloidea, Englm.
Euphorbia Fendleri, T. & G.
Euphorbia montana, Englm.
Celtis occidentalis, L.
Quercus alba, L., var. Gunnisoni, Torr.
Salix longifolia, Muhl., var.
Populus angulata, Ait.
Populus balsamifera, L., vars.
Corallorhiza multiflora, Nutt.
Cypripedium parviflorum, Salisb.
Yucca angustifolia, Pursh.
Scirpus validus, Vahl.
Muhlenbergia pungens, Thurber.
Calamagrostis longifolia, Hook.
Eriocoma cuspidata, Nutt.
Pleuraphis Jamesii, Torr.
Phragmites communis, L.
Triticum repens, L.
Pteris aquilina, L.
Pellæa gracilis, Hook, La Plata Mountains.
Cheilanthes lanuginosa, Nutt.
Woodsia Oregana, Eaton.

LIST OF MUSCI AND HEPATICÆ COLLECTED IN SOUTHERN COLORADO, MOSTLY BETWEEN 5,000 AND 9,000 FEET ALTITUDE, DETERMINED BY E. A. RAU, WITH THE ASSISTANCE OF C. F. AUSTIN AND T. P. JAMES.

Weissia viridula, Brid.
Weissia cirrhata, Hedw.
Weissia crispula, Hedw.
Weissia crispula, var.—Plants much smaller than in usual forms; leaves dark green, with much closer areolation.—Sierra Madre of Southwestern Colorado.
Gymnostomum rupestre, Schwaegr.—Mancos Valley.
Gymnostomum Brandegei, Austin, new species, Bulletin Torrey Botanical Club, vol. vi, p. 46.—Cañon City.
Dicranum scoparium, L.—Southwestern Colorado.
Dicranum rhabdocarpum, Sulliv.
Dicranum (Campylopus) Rauei, nov. sp., C. F. Austin.

Caule brevi compacte cæspitoso inferne dense tomentoso-radiculoso; foliis erectiusculis, subtortuosis, lineali-lanceolatis, semel tortis valde convoluto-concavis, dorso indistincte papillosis margine ad apicem subserratis; costa angusta, excurrente; reti minuto cellulis angularibus perpaucis paulum inflatis; capsula subcylindrica, erecto-incurva pallida laeviuscula, seta brevi tenui flexuosa, operculo longe rostrato; annulo angusto, calyptra solum, operculi rostrum obtegente: color læte fulvo-virens. Colorado—1875—T. S. Brandegee (Rau). About the size of D. flagellare. Leaves shaped about as in D. flagellare (costa more solid, otherwise similar); once twisted as in D. Schraderi, convolute-concave much as in D. Muhlenbeckii; reticulation much as in D. fulvum. Color, shape, and texture of the capsule also much as in D. Schraderi, but that has a straight and longer pedicel, much larger calyptra, lighter costa, and cells at the base of the leaf more lax, those above more granulose, margins more decidedly serrate, &c., besides it is a much larger species.

Fissidens exiguus, Sulliv.
Desmatodon cernuus, Br. Eu.
Desmatodon latifolius, Br. Eu., var. β. glacialis.
Didymodon rubellus, Br. Eu.

Distichium capillaceum, Br. Eu.
Barbula ruralis, Hedw.
Trichostomum tophaceum, Brid.
Ceratodon purpureus, Brid.
Ceratodon purpureus, var. xanthopus.
Encalypta vulgaris, Hedw.
Encalypta vulgaris, var. obtusa.
Encalypta vulgaris, var. with leaves very obtuse, obovate oblong; costa shorter than in the preceding; peristome pale and fugacious. A fine variety, very distinct from the former, both in shape of the leaves and in the presence of a fine peristome.
Encalypta ciliata, Hedw.
Orthotrichum anomalum, Hedw.
Orthotrichum cupulatum, Hoffm., var. minus.
Orthotrichum Sturmii, H. & H.
Orthotrichum Kingianum, Lesq.
Orthotrichum Watsoni, James.
Coscinodon Wrightii, Sulliv.—Cañon City.
Coscinodon Rauei, Austin, new species, Bulletin Torrey Botanical Club, vol. vi, p. 46.—Cañon City.
Grimmia Brandegei, Austin, new species, Bulletin Torrey Club, vol. vi, p. 47.—Cañon City.
Grimmia obtusa, Schwaegr.
Grimmia calyptrata, Hook.
Grimmia anodon, B. & S.
Grimmia apocarpa, Hedw.
Grimmia apocarpa, var. leaves broader and shorter; peristome paler; teeth narrower.
Grimmia plagiopodia, Hedw.
Grimmia ovata, W. & M.
Tayloria serrata, B. & S.
Funaria hygrometrica, Hedw.
Funaria hygrometrica, var. patula.
Bryum pyriforme, Hedw.
    cruduum, Schreb.
    nutans, Schreb.
    cernuum, Hedw.
    intermedium, Brid.
    cirrhatum, H. & H.
    bimum, Schreb.
    pallescens, Schwaegr.
    cæspiticium, Linn.
    argenteum, Linn.
    obconicum, Hornsch.
    pseudotriquetrum, Hedw.
    turbinatum, Hedw.
    turbinatum, var. latifolium.
Mnium cuspidatum, Hedw.
    affine, Bland.
    serratum, Schrad.
Timmia megapolitana, Hedw.
Polytrichum juniperinum, Hedw.
Fabronia Wrightii, Sulliv.—Cañon City.
    Wrightii, var. of a larger growth; leaves less strongly serrate.
Leskea polycarpa, Hedw.

Pseudoleskea atrovirens, Schwaegr., var. brachycladus.
Brachythecium denticulatum, Linn.
rivulare, Br.
collinum, Schp.
collinum, var.
Utahense, James.—Cañon City.
Fendleri, Sulliv.—Cañon City.
Eurynchium strigosum, Hoffm.
diversifolium, Br. Eu.
Amblystegium confervoides, Schwaegr.
minutissimum, S. & L.
serpens, Linn.
orthocladon, Beauv.
radicale, Brid.
compactum, C. Mull.
Stereodon plicatile, Mitt.
Limnobium palustre, Br. Eu.
Hypnum filicinum, Linn.
uncinatum, Hedw.
reptile, Michx, var.
curvifolium, Hedw.

HEPATICÆ.

Marchantia polymorpha, Linn.
Jungermannia pumila, With.
trichophylla, Linn.
Scapania compacta, L.
Reboulia hemisphærica, Rad.

BRIEF SYNOPSIS OF NORTH AMERICAN EARWIGS, WITH AN APPENDIX ON THE FOSSIL SPECIES.

By Samuel H. Scudder.

The following synopsis includes all the species of *Forficulariæ* (thirty-eight in number) known to me from North America and the West Indies. Only fourteen of them occur within the limits of the United States, and of these one (*Forf. Percheroni*) is doubtful, and but nine are indigenous. The introduced species are *Labidura riparia*, *Anisolabis maritima*,* *Forficula Percheroni*, *F. auricularia*, and *Labia minor*. Those which I have not seen, and which are consequently described from the writings of others, with more or less inaccuracy on my part, are preceded by a dagger. Doubtless some of them, and especially those of Fabricius, may be entirely misplaced, or even synonymous with others, as they have not since been recognized, and few if any points of structure enter into the brief descriptions of the older authors. One is necessarily omitted. The descriptions have been made as brief as possible, and no synonymy is given; for the latter the student is referred to my list of described *Forficulariæ* of the whole world, now printing in the eighteenth volume of Proceedings of the Boston Society of Natural History. The length of the body is exclusive of the forceps; and where the colors and length of the wings are mentioned, reference is made only to the portion of the wings which is exposed when the insect is at rest.

I. *Sixth antennal joint much shorter than the first.*

A. *Sixth antennal joint no longer than broad.*

Thermastris. Whole body, but especially the anterior half, much flattened; antennæ very long, composed of more than 30 joints; prosternum pointed anteriorly; tegmina and wings present; first and third tarsal joints equal; second very small, simple; third joint furnished with a pad; second and third abdominal segments without lateral plications; forceps moderately stout, straight, either distant, incurved at tip (♂), or attingent (♀).

- Posterior edge of penultimate ventral segment rounded and entire ..... 1. *Chontalia.*
- Posterior edge of same rounded, but excised in the middle ..... 2. *Saussurei.*

1. *Chontalia* Scudd. Dull castaneous, the head, thorax, tegmina, and wings uniform black or blackish-brown, Body 18.5^{mm}; forceps ♀ 6.25^{mm}. Nicaragua.

†2. *Saussurei* Dohrn. Rufo-piceous, the elytra and wings rufo-fuscous, but the latter yellow on inner half; base of femora, apex of tibiæ, and whole of tarsi yellow. Body 19^{mm}; forceps ♂ 5^{mm}. Mexico.

* This may be indigenous, but it occurs over nearly the whole world.

I. *Sixth antennal joint much shorter than the first.*

B. *Sixth antennal joint nearly or quite twice as long as broad.*

1. First antennal joint as long as the fourth to the sixth joints inclusive.

a. Furnished with both tegmina and wings.

* Antennæ with more than twenty joints.

LABIDURA. Body flattened only in front, the abdomen tumid, especially above. Antennæ a little more than half as long as the body, the first joint enlarging much toward the tip; prosternum of equal width in front and behind. Tegmina and wings present; first tarsal joint equal to the other two, the second simple, third with no pad; second and third abdominal segments without lateral plications; forceps moderately stout, rather simple, slightly arcuate, distant at base (♂), or straight, incurved at tip, approximate (♀).

1. *riparia* Pall. A very variable species, but usually with the head dark castaneous; pronotum and tegmina dark fuscous, with an inner pale band; wings fuscous, pale interiorly; abdomen blackish above, castaneous on sides and also on dorsum of last segment; the legs luteous; antennæ with 27–30 joints; forceps of male with a slight tooth beyond middle of inner edge. Length 20^{mm}; forceps: ♂ generally about half the length of body, but sometimes much more; ♀ 5^{mm}. Texas, Florida, Cuba, Mexico, (and nearly the whole world).

[*Labidura advena* Mein. from Jamaica is unknown to me, and the description inaccessible.]

** Antennæ with less than twenty joints.

PSALIS. Body stout, the abdomen rather tumid; antennæ less than half as long as the body, the first joint long and increasing but little in size apically; prosternum broadening anteriorly. Tegmina and wings present; first tarsal joint equal to the other two, the second simple, the third padless; no lateral plications on abdomen; forceps slender, cylindrical, arcuate, widely distant (♂), or stout, trigonate at base, attingent, straight, and incurved at tip (♀).

a. { Wings extending conspicuously beyond the tegmina..*b.*
Wings extending but slightly beyond the tegmina, 1. *gagatina.*

b. { Tegmina with a light-colored spot on darker ground. 2. *procera.*
Tegmina unicolorous..... .... .3. *americana.*

†1. *gagatina* Klug. Shining piceous, the thirteenth and fourteenth and sometimes the adjoining joints of antennæ pale; tarsi and tibiæ rufous at the tip. Tegmina short; abdomen punctulate. Length 19^{mm}; forceps 4–5^{mm}. Porto Rico.

I. *Sixth antennal joint much shorter than the first.*

2. *procera* Burm. Shining castaneo-piceous, the mouth-parts castaneo-luteous, the antennæ brown, paler toward the tip, the legs luteous, the tegmina with a large rufo-luteous spot. Length 22^{mm}; forceps, ♂ 9^{mm}, ♀ 6^{mm}. West Indies and Central America (as well as northern parts of South America).

†3. *americana* Pal. Castaneous; mouth-parts and legs fulvous; antennæ 18-jointed; tegmina uniform in coloring throughout; forceps of female strongly incurved at the tip, denticulate on the basal half of inner margin. Body 21^{mm}; forceps ♀ 9^{mm}. St. Domingo and other parts of the West Indies and Central America.

b. Possessed of neither tegmina nor wings.

ANISOLABIS. Body long and slender, wholly apterous, of nearly equal width throughout; antennæ scarcely half as long as the body, with about 20 joints; first and last tarsal joints of about equal length, the second small, simple; second and third abdominal segments with very slight lateral plications; forceps short, rather stout, arcuate, similar in the two sexes, except in being much more arcuate in the male and generally a little asymmetrical.

{ Femora broadly annulated with fuscous..... 1. *azteca.*
{ Femora unicolorous ..... 2. *maritima*

†1. *azteca* Dohrn. Piceous, very delicately punctulate; tibiæ and tarsi testaceous; femora broadly annulate in the middle with fuscous, the ninth joint of the antennæ pale, the rest rufo-testaceous, like the mouth-parts. Body 9^{mm}; forceps 1^{mm}. Mexico.

2. *maritima* Bon. Blackish mahogany-brown; mouth-parts and legs luteous; antennæ luteous, more or less infuscated, the ninth joint of the same color as the rest. Body 18^{mm}; forceps 3^{mm}. North Carolina, South Carolina, Key West, Bermuda, Nicaragua (and nearly the whole temperate and subtropical world).

2. First antennal joint no longer than the fourth and fifth joints together.

SPONGOPHORA. Whole body flattened, long, and slender, the sides of the abdomen straight; antennæ more than half the length of the abdomen, 15–20-jointed, the joints rather long; tegmina and wings present; first tarsal joint longer than the other two together, the third scarcely longer than the simple second joint; pad minute; second and third abdominal segments with lateral plications; forceps very long, generally nearly straight, and either separated with a few teeth on inner edge (♂), or attingent and nearly or quite unarmed (♀).

I. *Sixth antennal joint much shorter than the first.*

a. Forceps longer than pronotum, tegmina, and wings together ..... b.
Forceps shorter than pronotum, tegmina, and wings together ..... 1. *brunneipennis.*

b. Exposed part of wings unicolorous ..... c.
Exposed part of wings black, with a colored spot on them ..... 2. *prolixa.*

c. Hind border of abdominal segments 3–5 beaded with a row of tubercles above ..... 3. *parallela.*
Hind border of abdominal segments 3–5 longitudinally and profusely striate above ..... 4. *forfex.*

1. *brunneipennis* Serv. Head, thorax, and tegmina blackish-castaneous; abdomen dark rich castaneous; wings yellow, edged within, and at apex with dark castaneous; palpi luteous; antennæ 14–15-jointed, brownish-luteous; legs honey-yellow; forceps half as long as abdomen, simple, straight, incurved at tip with a quadrate basal tooth within (♀), or two-thirds as long as abdomen, straight, incurved at extreme tip with a more or less prominent inner tooth before the middle or in middle of basal half. Body 9^{mm}; forceps, ♂ 4^{mm}, ♀ 3^{mm}. Pennsylvania and Kentucky to Florida, Texas, Arizona, and Mexico.
2. *prolixa* Scudd. Blackish, the abdomen more or less tinged with castaneous; wings with a conspicuous fulvous spot; palpi, antennæ, and legs brownish-luteous, the latter more or less obscured with fuscous, and tinged with castaneous; forceps (♂) very variable and slender, either nearly as long as the body, straight and slender, incurved at tip with a minute tooth before the middle of basal half, or not much longer than the abdomen, straight to beyond the middle, beyond bent abruptly inward, still straight but sinuous, the inner edge with a median spinous tooth. Body 23^{mm}. Mexico.
3. *parallela* Westw. Blackish-castaneous; tegmina reddish-brown; wings uniform tawny; palpi and antennæ brownish-fuscous; legs infuscated reddish-brown; forceps (♂) as long as the body, very slender, straight, but incurved at extreme tip with a minute tooth at or before the middle of basal half. Length 17^{mm}. Mexico, Nicaragua.
4. *forfex* Scudd. Dark castaneous-brown; mouth-parts scarcely paler; antennæ castaneous, infuscated beyond the base; legs luteo-castaneous, the front of femora blackish-fuscous; wings pale mahogany-brown. Forceps (♂) nearly as long as the body, very slender, straight but incurved at extreme tip, with a minute tooth just before the middle of the inner edge. Length 22^{mm}. Locality unknown; probably Central America.

II. *Sixth antennal joint as long, or very nearly as long, as the first.*

A. *Sixth antennal joint cylindrical, many times longer than broad.*

1. A minute scutellum exposed.

NEOLOBOPHORA. Head and thorax depressed; abdomen unusually tumid, subcylindrical, the sides full; antennæ more than half as long as the body, with less than twelve joints, mostly long and cylindrical; tegmina present; wings absent; first tarsal joint but little longer than the third, the second minute but produced below the third and bilobate; third joint without pad; second and third abdominal segments with distinct lateral plications; forceps long, slender, simple, nearly or quite attingent, unarmed, nearly or quite straight, and longer in the male than in the female.

1. *volsella* Scudd. Head reddish; rest of body black; mouth-parts and antennæ blackish, tinged with red, the latter growing paler toward tip; tegmina nearly square; legs luteous, with the apical half of the femora black; forceps reddish (♀), or black, reddish at base (♂), with a slight tooth in the middle of inner edge in male. Body 12^{mm}; forceps, ♂ 10.5^{mm}, ♀ 5^{mm}. Mexico.

2. No scutellum exposed between base of closed tegmina.

a. Abdomen greatly expanded in middle; penultimate and antepenultimate dorsal segments in male very short.

ANCISTROGASTER. Body depressed, but abdomen somewhat tumid as well as broadly expanded in the middle; antennæ nearly as long as the body, 12-jointed, the joints unusually long; tegmina and wings present; legs long and slender, first and last tarsal joint nearly of the same length, the second short but produced far below the third and bilobed; third joint without pad; second and third abdominal joints with lateral plications, and fourth and fifth joints with extreme lateral posterior prolongations; forceps not so long as abdomen, subcylindrical, either straight, attingent, simple (♀), or strongly bowed, the tip expanded and toothed, the extreme base with an inner tooth (♂).

Sides of fourth and fifth abdominal segments slightly and sharply produced posteriorly.... .....1. *gulosa.*
Sides of third, fourth, and fifth abdominal segments greatly and sharply produced posteriorly .....2. *spinax.*

1. *gulosa* Scudd. Very dark brown; palpi and antennæ pale brown; wings pale dull luteous; posterior prolongations of fourth and fifth segments inconspicuous; legs dull luteous, more or less infuscated; forceps of the male with the tip depressed laminate, either extremity of it produced to a fine point, the middle of inner border smooth. Body 11^{mm}; forceps, ♂ 4^{mm}, ♀ 3^{mm}. Mexico.

II. *Sixth antennal joint as long, or very nearly as long, as the first.*

† 2. *spinax* Dohrn. Blackish; eighth segment of antennæ pale at tip; base and extreme tip of wings and whole of tarsi pale yellow; third, fourth, and fifth dorsal segments of abdomen conspicuously prolonged laterally in a backward curve, tapering and pointed; forceps of male with the tip bearing a backward-directed hook, and the middle of inner border denticulate. Body 11^{mm}; forceps 4^{mm}. Mexico.

b. Abdomen but little or not at all expanded in the middle; all the dorsal segments before the last of nearly equal length in both sexes.

FORFICULA. Whole body more or less flattened, generally long and slender; antennæ usually a little more than half as long as the body, 10–14-jointed, the joints cylindrical, scarcely larger at the apex than at the base, seldom as little as four times as long as broad; tegmina present; wings usually present; first tarsal joint a little longer than the third, the second short, but dilated apically and lobate, passing beneath the third joint; second and third abdominal segments with lateral plications; forceps of varied construction.

a. { Wings protruding beyond the tips of the tegmina....*b.*
Wings wanting, or shorter than the tegmina.....*k.*

b. { A large pale spot at base of tegmina.....*c.*
Tegmina concolorous or vittate .....*d.*

c. { Wings unicolorous; forceps slender..... 2. *bimaculata.*
Wings bicolorous; forceps stout.....3. *Percheroni.*

d. { Male forceps with an inward and upward directed basal lamella.....4. *lugubris.*
Male forceps with no such lamella.....*e.*

e. { Middle legs very much nearer the fore legs than the hind legs.... .....*f.*
Middle legs only a little nearer the fore legs than the hind legs .....*h.*

f. { Male forceps attingent at extreme base..5. *auricularia.*
Male forceps widely separated at extreme base.....*g.*

g. { Tegmina longitudinally vittate.....6. *tæniata.*
Tegmina concolorous.....7. *tolteca.*

h. { Inner edge of male forceps with a post-median tooth. 8. *exilis.*
Inner edge of male forceps with no distinct post-median tooth .....*i.*

i. { Inner edge of male forceps sharply and profusely denticulate .....9. *californica.*
Inner edge of male forceps with a single sharp basal tooth .....10. *pulchella.*

k. { Forceps of male long, but shorter than abdomen, only a little curved.....11. *aculeata.*
Forceps of male longer than abdomen, but little curved.....12. *ruficeps.*
Forceps of male short, strongly bowed.....13. *rara.*

11. ***Sixth antennal joint as long, or very nearly as long, as the first.***

(*F. albipes* and *F. elongata*, known only from the short descriptions of Fabricius, are not inserted in this table, and the descriptions of them below are but adapted translations from Fabricius's Entomologia Systematica.)

† 1. *albipes* Fabr. Black; mouth-parts pale; antennæ fuscous; posterior border of thorax, base of tegmina, wings and legs whitish; abdomen shining, the borders of the segments reddish; forceps small, black; of medium size. West Indies.

† 2. *bimaculata* Pal. Dark ferruginous; sides of prothorax pale; base of tegmina with a large, oval, pale yellow spot; wings wholly pale yellow; antennæ, palpi, and legs brown; forceps of ♀ small, simple, slender, incurved at tip. Body 12^{mm}; forceps 2.5^{mm}. St. Domingo.

3. *Percheroni* Guer. Head, thorax, and legs tawny; antennæ brownish, with two middle joints tawny; tegmina and abdomen black, the former with a large, basal, yellow spot, not reaching the suture; wings yellow at base, black at tip; forceps rather stout, simple, incurved. Body 18.5^{mm}; forceps 4^{mm}. Described from Cayenne, but is presumed to have been found in Massachusetts in a single instance, since there is a specimen in the Harris collection (described by me as *Spongophora bipunctata*), catalogued "May 20, 1827, from Z. Cook, esq."

† 4. *lugubris* Dohrn. Shining piceous; palpi and antennæ reddish-brown; prothorax narrower than the head, yellow on the sides and at extreme hind border; tegmina a little longer than the prothorax; wings with a yellow dot at end of inner margin; legs ferruginous; forceps of male about half as long as the body, slender, bent a little inward next the base, then strongly outward and incurved at tip, subcristate on basal third. Body 10^{mm}; forceps 4–6^{mm}. Mexico.

5. *auricularia* Linn. Fusco-ferruginous; antennæ 14–15-jointed; basal joint, sides of pronotum, and legs testaceous; tegmina and wings dull luteous, the former half as long again as the pronotum; forceps of male usually as long as the abdomen, horizontal, depressed, and dilated at the base, and beyond rather strongly arcuate, tapering to a point, the extreme base of inner edge tuberculato-denticulate, with a distinct inner tooth at base of arcuate portion. Body (average) 11^{mm}; forceps, ♂ 4–8^{mm}, ♀ 3^{mm}. New York, Cuba (Para, Europe, Northern Africa, Western Asia, Madeira). The only New York male I have seen has short forceps. It is undoubtedly an introduced insect.

6. *tæniata* Dohrn. Piceous; head rufous; antennæ 12-jointed, rufous; mouth-parts and sides of prothorax testaceous; tegmina and wings luteo-testaceous, their inner margin rather broadly edged with black;

II. *Sixth antennal joint as long, or very nearly as long, as the first.*

legs luteo-testaceous; forceps of male more than half as long as the abdomen, gently arcuate, the inner edge slightly angulated at end of basal third, the whole tuberculate, with a pre-apical slightly inferior tooth. Body 11–15^{mm}; forceps, ♂ 4.5–5.5^{mm}, ♀ 3–3.5^{mm}. Cuba, Arizona, Texas, Mexico, Guatemala, Panama (Brazil).

7. *tolteca* Scudd. Head rufous; palpi and base of antennæ as well as prothorax luteous, rest of antennæ light brown, the tenth joint pale; tegmina dark brown, twice as long as pronotum; wings and legs luteous; abdomen dark castaneous; whole body sparsely pilose; forceps of female more than half as long as abdomen, simple. Body 8^{mm}; forceps 2.4^{mm}. Mexico.

8. *exilis* Scudd. Mahogany-brown, the pronotum rufo-luteous; palpi brownish-luteous; antennæ reddish-brown; tegmina nearly twice as long as pronotum, and with the wings and legs luteous; forceps of male very slender, more than half as long as the abdomen, gently arcuate, slightly expanded interiorly at the base, the basal half of inner edge denticulato-tuberculate, the middle of apical half with a slight tooth. Body 10.5^{mm}; forceps 3.75^{mm}. Texas.

†9. *californica* Dohrn. Castaneo-fuscous; pronotum rather narrower than the head, longer than broad, the sides testaceous; tegmina twice as long as pronotum and like the wings testaceous, the suture broadly fuscous; legs testaceous; forceps of male less than half as long as the body, rather broad at the base, gently arcuate, the inner margin sharply and profusely denticulate, smooth beyond the middle. Body 10^{mm}; forceps 3^{mm}. California.

†10. *pulchella* Serv. Head blackish; antennæ 11-jointed (?), brownish, paler at the base; pronotum brown, the sides and posterior margin paler; tegmina brown; wings yellow, edged with brown; abdomen reddish-brown; forceps of male arcuate in the middle, pointed, with an inner tooth near the base. Body 8; forceps, ♂ 5^{mm}, ♀ 2.5^{mm}. Niagara, N. Y.

11. *aculeata* Scudd. Dark castaneous; palpi luteous; antennæ 12-jointed, dark brown; pronotum longer than broad, narrower than the head, the sides pale luteous; tegmina nearly twice as long as the pronotum, luteous, broadly margined with fuscous interiorly; legs luteous; forceps of male three-fourths as long as the abdomen, slender, arcuate, bent downward a little beyond the base, and again horizontal a little before the tip, with a slight pointed tooth at end of descending portion; pygidium aculeate. Body 11^{mm}; forceps, ♂ 5^{mm}, ♀ 3.5^{mm}. New York, Northern Illinois, Southern Michigan.

†12. *ruficeps* Burm. Black, the head and antennæ reddish-brown; prothorax as broad as the head; tegmina somewhat longer than the pronotum; femora black.

II. *Sixth antennal joint as long, or very nearly as long, as the first.*

griseous at base; tibiæ reddish-brown; tarsi yellow; forceps of male nearly as long as the body, nearly straight, incurved at tip, with a median inner tooth. Body 14mm; forceps, ♂ 11mm, ♀ 5mm. Mexico.

13. *vara* Scudd. Dark maghogany-brown, the prothorax a little lighter; palpi and antennæ dark luteous, the latter 11–12-jointed; pronotum scarcely as long as broad, as broad as the head, the sides dull luteous; tegmina a little longer than the pronotum, dark brown; legs luteous; forceps of male less than half as long as abdomen, strongly arcuate, and also sinuate when viewed laterally; inner edge minutely denticulate at base, beyond crenulate. Body 8mm; forceps, ♂ 3mm, ♀ 2.6mm. Mexico.

†14. *elongata* Fabr. Dark fuscous; head ferruginous; antennæ yellowish; margin of prothorax pale; tegmina and legs uniform pale; abdomen dull ferruginous in the middle, darker at the end; forceps long, arcuate, pale at base, fuscous at tip, with a single basal inner tooth of medium size. West Indies.

B. *Sixth antennal joint plainly obconic.*

LABIA. Of small size. Whole body flattened, long, and slender; the abdomen occasionally a very little tumid; antennæ about half as long as the body, 10–13-jointed, the joints moniliform or obconico-fusiform, seldom more than three times as long as broad; tegmina present; wings present or absent; first and third tarsal joints equal, the second minute, perfectly simple, compressed; second and third abdominal segments with lateral plications; forceps seldom more than half as long as the abdomen, in the male generally simple, arcuate, horizontal; in the female simple, straight, incurved at tip, unarmed.

a. Wings wanting, or shorter than the tegmina.....*b.*
Wings protruding beyond the tips of the tegmina ....*c.*

b. Last ventral segment of male very broadly rounded posteriorly, half as long as broad .....1. *Burgessi.*
Last ventral segment of male one-third as long as broad, the posterior border very convex.....2. *brunnea.*

c. Forceps of female flattened beneath, with sharp lateral edges .....*d.*
Forceps of female scarcely flattened beneath, with rounded lateral edges .....*e.*

d. Exposed part of wings, with a distinct yellow spot, 3. *guttata.*
Exposed part of wings unicolorous.....4. *melancholica.*

e. Last ventral segment of male with a long apical tubercle.....5. *minor.*
Last ventral segment of male (probably always) entire, *f.*

f. Lateral tubercle of third abdominal segment prominent, rounded.....6. *unidentata.*
Lateral tubercle of third abdominal segment scarcely more prominent than that of the second, 7. *rotundata.*

(*L. annulata*, known only by the description of Fabricius, is not included in this table.)

II. *Sixth antennal joint as long, or very nearly as long, as the first.*

1. *Burgessi* Scudd. Dark castaneous, the pronotum fusco-luteous; antennæ 13-jointed, the basal joints and the palpi luteous, darker beyond; tegmina fusco-luteous, but little longer than the pronotum; legs pale luteous; forceps of male about half as long as abdomen, slender, gently arcuate, with a large sub-basal and smaller postmedian tooth, the former depressed laminate. Body, ♂ 7–8^{mm}, ♀ 8–9^{mm}; forceps, ♂ 3^{mm}, ♀ 2.5^{mm}. Northern Florida.
2. *brunnea* Scudd. Dark castaneous; mouth-parts and antennæ somewhat luteous, the latter 11-jointed; pronotum nearly as broad as the head, of equal length and breadth, paler at the sides; tegmina castaneo-fuscous, fully half as long as the pronotum; legs castaneo-luteous; forceps of male a little more than half as long as the abdomen, simple, very gently arcuate, with a slight basal and pre-apical tooth on inner edge. Body 6.5^{mm}; forceps, ♂ 2.25^{mm}. Cuba.
3. *guttata* Scudd. Blackish-castaneous, the pronotum, tegmina, and especially the apical third of abdomen a little lighter; antennæ 12–13-jointed, at base luteous, like the palpi, beyond duskier; pronotum slightly narrower than the head in front, equal to it behind; edges fusco-luteous; tegmina half as long again as the pronotum; wings half as long as tegmina, brownish-fuscous, with a luteous spot in middle of base; legs bright luteous; forceps of male rather slender, rather more than half as long as the abdomen, shaped as in *L. Burgessi;* last ventral segment of male with an apical tubercle, long, equal, and very slender. Body 6^{mm}; forceps 2.5^{mm}. Texas.
4. *melancholica* Scudd. Blackish-castaneous, shining; antennæ 13-jointed, bright luteous at base, like the palpi, beyond infuscated, the tip dusky; pronotum as broad as the head posteriorly, a little longer than broad, the sides and hind border dark luteous; tegmina nearly twice as long as pronotum; wings nearly two-thirds as long as tegmina; legs luteous; forceps of male unknown, of female longer than usual, moderately stout, simple, straight, incurved at tip. Body 8.25^{mm}; forceps 2^{mm}. Texas.
5. *minor* Linn. Testaceous, pubescent. Head blackish; antennæ 10–12-jointed, fuscous; mouth-parts pale; pronotum narrower than the head, behind, as well as in front, scarcely longer than broad; tegmina nearly twice as long as the pronotum, the wings as long as the pronotum; legs pale luteous; abdomen rufo-testaceous in the middle above; forceps of male considerably more than half as long as the abdomen, rather heavy, distantly serrulate on inner edge; last ventral segment of male with an apical, compressed, upcurved, long, and slender tubercle. Body 3.75–6^{mm}; forceps, ♂ 1.25–2^{mm}, ♀ slightly less. Maine, New Hampshire, Massachusetts, Maryland, Virginia, Texas (Europe, Siberia, Madeira).

II. *Sixth antennal joint as long, or very nearly as long, as the first.*

† 6. *unidentata* Pal. Ferruginous; antennæ paler, 11-jointed; pronotum also paler, no longer than broad, scarcely narrower than the head; tegmina twice as long as the pronotum; wings pale yellowish, as long as the pronotum; legs pale ferruginous; forceps (of female?) nearly straight, scarcely bent inward, with a small postmedian inner tooth, the apex blunt, incurved. Body 7^{mm}; forceps 2^{mm}. St. Domingo.

7. *rotundata* Scudd. Dark mahogany-brown; antennæ 10-jointed, the basal joint, like the palpi, reddish-brown, beyond duskier; pronotum nearly as broad as the head, scarcely longer than broad, reddish-luteous, paler on sides; tegmina about half as long again as the pronotum, brownish luteous; wings blackish; legs luteous; abdomen broad, blackish toward the base; forceps of male unknown, of female scarcely one-third as long as the abdomen, simple, separated, straight, incurved at tip. Body 6^{mm}; forceps 1.5^{mm}. Mexico.

† 8. *annulata* Fabr. Black; antennæ 13-jointed, the first and penultimate joints with the mouth-parts pale; pronotum flat, the margin pale; legs pale, the femora with a fuscous annulation; forceps short, unarmed. Of small size. West Indies.

Index of species.

Note on the fossil species.

In this bulletin (II, 447–448), to which the reader is referred for full particulars, I described *Labidura tertiaria* from the Tertiary beds near Castello's ranch, South Park, Colo. By some accident, I described the single specimen known as a female; it is a male. A second specimen of this species, too broken to determine the sex, from near Florissant, Colo. (perhaps the same locality as the preceding), has been kindly placed in my hands by Prof. A. E. Foote. It shows that the species should hardly be referred to *Labidura*, but it seems to agree quite as little with any other living genus. Both the specimens, however, are too imperfect in the parts necessary to be studied in determining genera in this group, and especially in the tarsal and antennal joints, to warrant any change, and I await more material to determine the precise relationship of the animal.

Another specimen from near Florissant (Prof. A. E. Foote) evidently belongs to the same genus as the preceding, but differs specifically, and may be called *Labidura lithophila*. It is a female; the body is much flatter than that of *Labidura tertiaria*, the abdomen being equal on a side-view, and the whole surface appears to be minutely punctulate; the

form of the head cannot be determined; the antennæ approach in length the body, the first joint nearly cylindrical, scarcely enlarging at the tip, about four times as long as broad; the comparative or actual length of the succeeding joints cannot be determined; the prothorax has its hinder margin entire and flat; the tegmina are a little longer than the prothorax, their hinder edge straight and apparently oblique; the wings appear to have surpassed the tegmina; the legs are very short (especially the femora) and not stout; the abdominal joints are of equal length; the forceps are peculiar, having the appearance of being strongly bowed, although the specimen is a female; they are very stout at the base, rapidly and regularly diminish in size on the basal half (which is about equal in length to two-thirds the last abdominal joint), beyond which they are equal, about half as stout as the base, bent apparently rather strongly inward, and very broadly rounded at the tip, a form of forceps I have never seen in any living earwig. Length of body, including forceps, 14.5^{mm}; of antennæ, 11^{mm}; of pronotum, 1.85^{mm}; of tegmina, 2.5^{mm}; of hind femora, 1.8^{mm}; of forceps, 2.25^{mm}.

LIST OF THE ORTHOPTERA COLLECTED BY DR. A. S. PACKARD IN COLORADO AND THE NEIGHBORING TERRITORIES, DURING THE SUMMER OF 1875.

By Samuel H. Scudder.

1. A species of Locustarian, belonging near *Epphippiger*, is represented in the collection by a larva and two pupæ, taken on the foot-hills at the entrance to Clear Creek Cañon, July 3. It differs structurally from anything with which I am familiar.

2. *Scudderia* sp. Two pupæ, probably belonging to *S. curvicauda* (DeG.) Stål, were taken at Manitou, Colo., July 14.

3. *Xiphidium* sp. A single pupa, probably belonging to *X. saltans* Scudd. or perhaps to *X. ensiforme* Scudd., was taken in gardens at Salt Lake City, July 2.

4. *Ceuthophilus pallidus* Thom. A number of specimens, both ♂ and ♀, which I refer with some doubt to this species, were taken under rotten pine logs in Idaho, Colo., July 5. A single specimen, very young, was taken at Williams Cañon, Manitou, Colo., July 15.

5. *Stenopelmatus oculatus* nov. sp. This insect is closely allied to the typical *S. talpa* Burm., but differs from it conspicuously in the great prominence of the eyes, which are subpedunculated, being, with their base, as high as broad; the head is immense, globose, the prothorax narrows rapidly behind, the legs are exceedingly stout, with spines arranged as in *S. fasciatus* Thom. Length, 30^{mm}; breadth of head, 12^{mm}; length of hind femora, 13^{mm}; of cerci, 3.5^{mm}. 1 ♂. Utah.

6. *Caloptenus bivittatus* (Say). 3 ♂, Salt Lake City, gardens, July 21, where it was more common than *C. spretus*; 1 ♀, foot-hills, at entrance to Clear Creek Cañon, July 3.

7. *Caloptenus fasciatus* Scudd. 1 ♂, Golden, Colo., July 3; 2 ♀ and pupæ, on foot-hills at entrance of Clear Creek Cañon, July 3; 1 ♀, Garden of the Gods, Colo., July 13; 2 ♂, Lake Point, Salt Lake, July 26, when *C. spretus* was not seen.

8. *Caloptenus occidentalis* Thom. I refer a single male taken at Lake Point, Salt Lake, July 27, to this species; but it has reddish hind tibiæ, and may be distinct.

9. *Caloptenus spretus* Uhl. In abundance (pupa and imago) at Warrensburgh, Mo., June 5; 1 ♂, 2 ♀, Boulder, Colo., June 28; 1 ♂, 6 pupæ, Blackhawk, Colo., July 2; 4 pupæ, on foot-hills at entrance Clear Creek Cañon, July 3; 2 ♀, summit of Pike's Peak, July 4; young, Williams Cañon, Manitou, Colo., July 15. Those taken on Pike's Peak had slightly shorter wings than the others.

10. *Caloptenus minor* Scudd. A single female, apparently of this species, but having reddish hind tibiæ, was taken at Salt Lake City July 21. It was not common in the imago-state; but pupæ, supposed to belong to this species, were seen.

11. *Pezotettix Dodgei* Thom. A pair of specimens taken in American Fork Cañon, Utah, are provisionally referred to this species, the descrip-

tion of which is insufficient. They differ from the description in the comparative length of the tegmina and hind femora, and in the color of the latter. In these specimens, they measure as follows: tegmina, ♂ 3.5^{mm}; ♀ 4.5^{mm}; hind femora, ♂ ♀ 10^{mm}.

HESPEROTETTIX *nov. gen.* (ἕσπερος, τέττιξ).

Allied to *Pezotettix* and *Caloptenus*. Head not very prominent; vertex very narrow between the eyes, with a slight median pit; the fastigium broadening considerably in front, declivant, shallowly sulcate in the middle, the sides rounded; front straight, a little (♀) or considerably (♂) oblique; the frontal costa equal, scarcely contracted at the extreme summit; antennæ slightly longer than the head and prothorax together; eyes slightly prominent, a little more so in the male than in the female. Pronotum rather long, nearly equal, broadening a very little posteriorly, transversely arched, with a scarcely perceptible median tectiform carina and well-rounded lateral margins; the hind scarcely longer than the front lobe; the hind border delicately marginate, obtuse-angled; prosternal thorn rather long, conical, compressed, bluntly pointed; meso- and metastethia together much longer than broad. Tegmina and wings reaching the tip of the abdomen. Femora as long as the abdomen, the superior carina slight, unarmed; hind tibiæ slender, the spines of either side of equal length, scarcely diverging, the upper lateral margins smooth and rounded; first joint of hind tarsi scarcely longer than the third, the second small, with a large inferior apical lobe; pulvillus large, nearly twice as long as broad.

12. *Hesperotettix viridis* (*Ommatolampis viridis* Thom.). 1 ♂, Lake Point, Salt Lake, July 26.

13. *Mermiria neomexicana* (*Opomola* (sic!) *neomexicana* Thom.). Two pupæ were brought home, one from the foot-hills at the entrance to Clear Creek Cañon, July 3, the other from Williams Cañon, Manitou, Colo., July 15.

14. *Chrysochraon deorum* nov. sp. Head large, prominent; fastigium of vertex broad, scarcely acute-angled in front; lateral foveolæ scarcely depressed, subquadrate, nearly twice as long as broad, the inner angle rounded, the edges shining; frontal costa with straight edges, scarcely broadening below, flat, distantly punctate in two rows, below the ocellus vanishing; whole front faintly and very sparsely punctate, the cheeks smooth. Pronotum gently constricted in the middle, the front border a little full, the hind border very obtusely angled; median carina equal, slight. The general color is brown, the face and antennæ with a reddish tinge, the cheeks a little ashen, the vertex pallid, with a pair of narrow, blackish stripes next the upper edge of the eyes, which follow along and are intenser upon the lateral edges of the fastigium, and extend backward to the pronotum. There is a broad dusky band behind the middle of the eyes, which extends over the lateral margin of the pronotal disk, broken by a slender, oblique, yellowish-brown line, which extends forward from the base of the tegmina, and, having divided this belt, faintly follows its upper margin to the eye. The tegmina are shorter than the abdomen, pallid, brown on the basal third of the upper area, the basal two-thirds of the median area, and the upper edge of the lower area; beyond, a few coarse brownish flecks. Wings scarcely shorter than the tegmina, pellucid, the upper veins dusky, the middle ones bluish. Hind femora reddish-brown, more or less infuscated along the upper margin, the apex black; hind tibiæ red, black at extreme base, the spines red at base, black at tip; abdomen yellowish, tinged

above with orange. Length of body, 15^{mm}; of antennæ, 8.25^{mm}; of tegmina, 8.25^{mm}; of hind femora, 10^{mm}. A single male was taken in the Garden of the Gods, Colo., July 13.

15. *Scyllina delicatula* nov. sp. Fastigium of vertex moderately broad, with prominent margins, slightly approaching each other in a curve posteriorly, acute-angled in front; lateral foveolæ rather large, rhomboidal, closely approximate; frontal costa with straight sides, regularly divergent, rather deeply sulcate, sparsely punctate, like the rest of the face; cheeks smooth; antennæ about as long as the head and pronotum together. Pronotum obtuse-angled posteriorly, the median carina equal, moderately prominent, severed scarcely in advance of the middle; the lateral lobes with a secondary, blunt, irregular, rugulose carina, extending from a little above the middle of the front border to the posterior extremity of the lateral carinæ. Color dusky-brown above, ashen or yellowish brown below, the front pallid brownish, the cheeks and vertex livid, the latter with a pair of dusky streaks extending backward from the lateral carinæ of the fastigium. Pronotum enlivened above with a reddish tinge, the lateral lobes more or less marked with blackish above, the lower third pale yellowish, with a yellowish longitudinal ruga on the middle of the posterior half. Tegmina surpassing the femora, fuliginopellucid, flecked with small, quadrate, more or less distinct, blackish spots along the median area, the base of upper area and the veins brown; wings scarcely shorter than the tegmina, pellucid, with a slight fuliginous stigma next the extremity of the front margin, the veins of the upper half of the wing blackish. Hind femora extending much beyond the abdomen, bluish livid, with a basal dash, and an oblique premedian streak of black on the outer side and above, and a slight infuscation along the upper margin; hind tibiæ pale reddish, the color fading toward the base; spines tipped with black. Length of body, 12.5^{mm}; of antennæ, 5^{mm}; of tegmina, 13^{mm}; of hind femora, 8.5^{mm}. 2 ♂, Garden of the Gods, Colo., July 13.

16. *Arphia luteola* Scudd. 1 ♂, Denver, Colo.; 1 ♀, Utah.

17. *Arphia arcta* nov. sp. Head grayish-brown above, yellowish elsewhere, the median carina of vertex broken at the posterior limit of the fastigium by the deeply-impressed, arcuate, transverse furrow, which marks the same, extending through the frontal costa nearly to the ocellus, expanding and forming an oval loop at the extremity; lateral foveolæ strongly depressed, narrowing interiorly. Pronotum grayish-brown, the upper surface unusually flat for an *Arphia*, rugulose, the median carina but little elevated, not laterally pinched in the middle, regularly, though but slightly, diminishing in height posteriorly. Tegmina profusely sprinkled with very small grayish-fuscous spots, less abundant apically, where it is pellucid. Wings yellow at the base, pellucid to an unusual extent at the tip (nearly one-third of the anteanal field is included in the pellucid area), making the transverse dusky band narrower than in any species of *Arphia* known to me; the radial shoot toward the base is, however, unusually broad and long, equaling at its origin the entire breadth of that part of the wing, and scarcely stopping short of the base. Hind femora brownish-yellow externally, with two broad, a little oblique, dusky, transverse bands; hind tibiæ pale yellow, with a broad fuscous cloud at the tip and just before the middle. Length of body, 21^{mm}; of antennæ, 8.5^{mm}; of tegmina, 22.5^{mm}; of hind femora, 11.5^{mm}. 1 ♂, Denver, Colo.

This species is more closely allied to the preceding than to any described species, but is smaller and differs from it in the narrowness of

the band on the wings, and in the structure of the upper surface of the pronotum.

18. *Hippiscus neglectus* (*Œdipoda neglecta* Thom.). 1 ♂, 1 ♀, Blackhawk, Colo., July 2; Manitou, Colo., July 14. I place this species temporarily in this group, to which it is somewhat closely allied, but from which it should doubtless be separated.

19. *Hippiscus Haldemanni* (*Œdipoda Haldemanni* Scudd.). 2 ♀, Garden of the Gods, Colo., July 13.

20. *Hippiscus corallipes* (*Œdipoda corallipes* Hald.). 1 ♂, 1 ♀, Boulder, Colo., June 29.

MESTOBREGMA (μεστός, βρέγμα) *nov. gen.*

Somewhat allied to *Psinidia* Stål. Head large; face horizontal; vertex tumid, but not so elevated as in *Psinidia*, broad between the eyes, the fastigium quadrate, depressed, with very high and abrupt lateral and frontal carinæ, which form the continuation of the sides of the equal, completely sulcate frontal costa; lateral foveolæ small, depressed, rudely semicircular, the ocelli situated beneath their outer extremity; eyes small, moderately prominent, but little longer and not so broad as the space between them; antenna (♀) about as long as the hind femora. Pronotum posteriorly as broad as the head, somewhat constricted in the middle, the hind lobe scarcely longer than the front, the posterior border rectangular; median carina moderately conspicuous, slightly higher on the front than on the hind lobe, twice deeply cleft, the transverse sulcations extending into the lateral lobes; lateral carinæ of posterior lobe prominent; surface of hind lobe nearly flat, pretty smooth; front lobe with a few oblique rugæ and small tubercles. Tegmina and wings surpassing the abdomen, the axillary vein of the former free; hind femora as long as the abdomen.

21. *Mestobregma Plattei* (*Œdipoda Plattei* Thom.). 1 ♀, Boulder, Colo., June 29.

CIRCOTETTIX (κίρκος, τέττιξ) *nov. gen.*

Somewhat closely allied to *Ctyphippus* Fieb., but differing considerably from it in general aspect. Head closely resembling that of *Trimerotropis* Stål; eyes rather smaller, somewhat prominent, separated above by a space about equal to their width; antennæ but little longer than the head and prothorax combined. Pronotum with the front lobe slightly narrower than the head, severed behind the middle; the hind lobe, which is about twice as long as the front lobe, broadening rapidly and greatly, slightly gibbous; the median carina distinct on the anterior portion of the front lobe, obsolete on the posterior portion, and inconspicuous on the hind lobe; front margin scarcely angulate; hind margin rectangulate; lateral carinæ distinct on posterior lobe, but not prominent; surface slightly rugulose. Tegmina and wings much longer than the body, the former with the intercalary vein approximating the radial at its tip, the axillary vein free; wings peculiar, being falcate (Thomas calls it papilio[ni]form), with more or less undulate margin; the falcation arises from the prolongation of the pre-anal area and the fullness of the middle of the anal area; the principal veins of the latter are supported on either side by spurious veins, running very close beside and parallel to them, to which the transverse veins are attached, while the spurious veins are themselves united to the principal nervures by other cross-veins, forming a more or less regular net-work on either

side of the principal veins; with this exception, the neuration of the wing is unusually regular and scalariform, the veins of the apex resembling somewhat their disposition in *Ctyphippus*.

The type of this genus is *Œdipoda undulata* Thomas. *Œdipoda sparsa* Thom. also belongs here, and I have a third undescribed species of the genus from Nevada, sent me by Mr. H. Edwards.

22. *Circotettix undulata* (*Œdipoda undulata* Thom.). 1 ♂, Manitou, Colo., July 14.

23. *Trimerotropis citrina* nov. sp. Ash-gray, blotched with dark fuscous; foveolæ of the head moderately distinct, a slight, lozenge-shaped, flat depression at the tip of the fastigium; antennæ yellowish-brown, obscurely annulated with fuscous. Median carina of pronotum distinct only on front lobe, and on its anterior part somewhat elevated, deeply cleft by the transverse sulcations, and sometimes depressed below the general level of the surface at the hindmost sulcation; front lobe corrugate, hind lobe nearly flat, granulose, with a few small, scattered tubercles, the posterior margin rectangular. Tegmina and wings extending far beyond the abdomen, the former as in *T. vinculata* Scudd., but much more uniform, the transverse ashen bands being more infuscated, and very rarely so distinct as in that species; wings rather pale lemon-yellow at base, pellucid, with black nervules at apex, and near the middle furnished with a broad, blackish, or very dark fuliginous band, shaped as in *T. vinculata*, but a little broader; beyond it, half-way to the apex of the wing, the space between the anterior two veins is more or less distinctly castaneous. Hind femora as in *T. vinculata*, hind tibia rather pale coral-red, becoming very pale at the base, the spines black-tipped. Length (of average specimens), ♂ 0.23^{mm}; ♀ 28.5^{mm}; of antennæ, ♂ 12, ♀ 10.5^{mm}; of tegmina, ♂ 27.5^{mm}, ♀ 31.5^{mm}; of hind femora, ♂ 12.5, ♀ 15^{mm}. A single male was taken at Denver, Colo., July 10. I have also specimens from the Red River of the North (Kennicott) to Texas (Belfrage, Boll). Boll's specimens were taken in Dallas County, June 6. Belfrage found the species "common in sandy places" in October and November, and a few also in June and July in the same State. The species seems to vary somewhat, northern specimens differing from the southern in having a paler band on the wings, the tegmina more distinctly fasciate, and the disk of the pronotum more depressed at the posterior sulcation. It is closely allied to *T. vinculata*, but the color at the base of the wings is deeper, the black band is broader, the tegmina are rarely so distinctly fasciate, and the hind tibiæ are red instead of yellow.

24. *Trimerotropis suffusa* nov. sp. Color varying from blackish-brown to very dark olive-brown above, the sides, and of the head the face, changing from livid below to brown above, all flecked heavily with black dots and blotches, the general effect being a speckled gray; antennæ very dark brown, faintly annulate with fuscous. Tegmina dark brown, suffused with blackish clouds on the basal half, heavily flecked with moderately large, quadrate, blackish-brown spots on the outer half, the cross-veins here and there brownish-yellow. Wings pale-citron on the basal half, separated from the outer half by a nearly straight line parallel to the body (when the wing is completely extended); outer half blackish fuliginous, deepest at apex and next the middle of the wing, and emitting a broad tapering shoot next the ulnar vein half-way from the middle of the wing toward the base; occasionally, the middle of the fuliginous area is semi-pellucid; the middle half of the apical four-fifths of the costal margin is blackish, sometimes as far as the radial vein; hind legs as in *T. verruculata*. Length (Utah specimen) of body, 27^{mm}; of antennæ, 11^{mm}; of tegmina, 29^{mm}; of hind femora, 13.5^{mm}.

1 ♀, American Fork Cañon, Utah. I have also received specimens from Mr. Henry Edwards from California and Vancouver's Island (No. 2), which are a little larger; the above description is in fact based upon them, as Dr. Packard's specimen was collected in alcohol.

This species is closely allied to *T. verruculata* (Kirb.) Scudd., which Mr. Edwards has also sent me from Vancouver's Island (No. 4), but differs from it in the more uniform distribution of the spots on the tegmina (*T. verruculata* always showing a couple of distinct, median, transverse, grayish bars), and in the extent of the fuliginous area of the wings, which in *T. verruculata* is confined to the extreme apex and to a narrow median band, sometimes so narrow as to be nearly broken in the middle.

AULOCARA (αὐλών, κάρα) *nov. gen.*

Not very distant from *Acrotylus* Fieb. Head large, tumid, the fastigium of the vertex pretty strongly declivant, scarcely depressed, its rounded lateral carinæ convergent to a blunt apex, by which it is separated from the frontal costa; lateral foveolæ distinct, pretty large, triangular, longer than broad, the lower edge horizontal; frontal costa narrow above, regularly broadening, fading out midway between the ocellus and the clypeus, sulcate throughout; eyes rather small, scarcely longer than broad, slightly shorter than the anterior part of the cheek, rather prominent, above nearly as distant as their breadth; antennæ very long and slender, scarcely depressed, fully as long as the hind femora. Pronotum very short, no longer than the head, constricted in the middle, the lobes equal in length; median carina very slight, equal, the front lobe twice distinctly severed in its posterior half, all the sulcations running distinctly a little way into the lateral lobes; lateral carinæ slight but distinct, excepting between the sulcations; lateral lobes scarcely narrowing below. Tegmina and wings reaching or surpassing the tip of the abdomen, the former with free, short, axillary vein, no intercalary vein and very few spurious veins. Hind femora rather stout and broad, with rather prominent carinæ; first hind tarsal joint longer than the third; arolium minute. The insects of this group have much the aspect of *Stenobothri*. The type of the genus is the species *cæruleipes*, now to be described.

25. *Aulocara cæruleipes* nov. sp. Head brown, heavily obscured above with broad longitudinal dark-brown or blackish stripes, made up of transverse bars; the face and cheeks more or less blotched with livid, becoming pale dull blue in front; clypeus and labrum pale brown, the edge of the latter pallid, like the palpi; antennæ brownish-yellow at base, beyond black or blackish. Pronotum brown, darkest above, the median carina darker; lateral lobes, with the upper border, blackish, and a pair of attingent, transverse, quadrate, black patches, the hinder a little the higher, in the middle. Tegmina surpassing the abdomen, brownish-fuscous, the posterior margin narrowly and the outer two-thirds of the anterior margin more broadly pallid, the middle area sparsely sprinkled with small, quadrate, fuscous spots, more abundant apically; wings pellucid, with a scarcely perceptible bluish tinge, the veins bluish, excepting the outer half of the upper portion, where they are black, or, at the extreme apex above, brownish. Outside of hind femora yellowish-brown, their upper half with a median and pre-apical, oblique, black patch, the latter tinging also the inferior surface; inside of femora blue, with a transverse, pre-apical, black patch; the whole apex bluish-black; hind tibiæ deep blue, the base yellowish-brown on the sides, spines black-tipped; hind tarsi pale yellowish-brown. Abdo-

men dull yellow, the upper surface marked transversely with brown. Length of body, 18.75^{mm}; of antennæ, 12.5^{mm}; of tegmina, 15^{mm}; of hind femora, 12^{mm}. 4 ♂. Garden of the Gods, Colorado, July 13.

26. *Aulocara decens* nov. sp. This species differs but little from the preceding, and may possibly belong with it, but it is paler-colored, less variegated, and has shorter tegmina and wings. The head, excepting the dark-brown vertex, is uniform very pale yellowish-brown; the clypeus and labrum very pale dull straw-yellow, almost white; more than a third of the antennæ is pale at the base. The tegmina are scarcely as long as the abdomen, light brown on the basal half of the middle area and basal third of the front area, the rest pallid or very pale brown, sparsely sprinkled with brownish dots. Hind tibiæ pale blue, with a broad, pallid, basal annulus. Abdomen yellow throughout. Length of body, 17.5^{mm}; of antennæ, 11.75^{mm}; of tegmina, 11.75^{mm}; of hind tibiæ, 11^{mm}. 1 ♂. Lake Point, Salt Lake, July 26, where they were common.

27. *Acrolophitus hirtipes* (Say) Thom. 2 ♀. Golden, Colo., and foothills at entrance to Clear Creek Cañon, July 3.

28. *Brachystola magna* (*Brachypeplus magnus* Girard). A single pupa was taken at the Garden of the Gods, Colo., July 13. This generic name, derived from βραχύς and στλοή, is proposed in place of *Brachypeplus* Charp. (*B. virescens* Charp. is the type), which is pre-occupied in Coleoptera (Erichs., 1842).

29. *Platamodes pennsylvanica* (De G.) Scudd. 1 ♂. Salina, Kans., in a house.

Stenopelmatus oculatus and *Cratypedes lineata* are described from specimens dried after immersion in alcohol; the remaining species from ordinary cabinet-specimens.

NOTICE OF A SMALL COLLECTION OF BUTTERFLIES, MADE BY DR. A. S. PACKARD, IN COLORADO AND UTAH, IN 1875.

By Samuel H. Scudder.

The collection has some interest, as it contains several rare forms, and extends our knowledge of the geographical distribution of many of the species. Thirty-three species in all were obtained, and of these eight have not been previously known in the Territory in which they were taken.

1. *Œneis Semidea* (Say). A single specimen was taken, July 14, on Pike's Peak, at an elevation of 13,000 feet. Although this has previously been reported from the Rocky Mountains of Colorado, it has always seemed questionable to me whether the allied form *Œ. Œno* was not meant. A careful study of a number of specimens, and a comparison of the abdominal appendages, leave no reasonable doubt that *Semidea* is an inhabitant of the Rocky Mountain summits, as well as of those of the White Mountains, New Hampshire.

2. *Erebia Epipsodea* Butl. Pike's Peak, just above timber-line, July 14.

3. *Cœnonympha ochracea* Edw. Pike's Peak, 8,000 feet, July 14.

4. *Danaida Plexippus* (Linn.). Pike's Peak, 8,000 feet, July 14.

5. *Chlorippe Lycaon* (Fabr.). Golden, Colo., July 3. I am not aware that this has ever before been found west of the great plains.

6. *Polygonia Satyrus* (Edw.). Salt Lake City, July 21.

7. *Polygonia Zephyrus* (Edw.). Georgetown, Colo., July 8.

8. *Papilio Antiopa* Linn. Salt Lake City, July 21.

9. *Vanessa cardui* (Linn.). Boulder City, June 29; Denver, July 10; Pike's Peak, from 8,000 feet to summit, July 14; Arapahoe Peak, 11,000 to 12,000 feet.

10. *Euptoieta Claudia* (Cram.). Manitou and Garden of the Gods, Colo., July 13; Pike's Peak, 8,000 to 9,000 feet, July 14.

11. *Argynnis Meadii* Edw. American Fork Cañon, Utah, July 22. I formerly questioned whether this were distinct from *A. Edwardsii*, but it now seems to me to be so. It has not been hitherto reported out of Colorado.

12. *Argynnis Hesperis* Edw. American Fork Cañon, Utah, July 22; also known hitherto only from Colorado. A single specimen was taken with the colors as in Edwards's figures, but with the marking of both the upper and under surfaces heavier, almost exactly as in *A. monticola*.

13. *Brenthis Helena* (Edw.). Pike's Peak, from timber-line upward, July 14.

14. *Lemonias Anicia* (Doubl.-Hewits.). The alpine form *nubigena* was taken at Pike's Peak, from the timber-line upward, July 14.

15. *Phyciodes pratensis* (Behr.). The form *campestris* was taken at Denver, June 27, Georgetown, July 8, and Manitou, July 16.

16. *Thecla Edwardsii* Saund. A very worn specimen, but unquestionably of this species, was taken at Manitou, Colo., July 16. It has never before been reported west of Iowa.

17. *Thecla Liparops* Lec. Taken with the preceding, and similarly worn. Kansas has hitherto been its westernmost known limit.

18. *Hypaurotis Chrysalus* (Edw.). A fine specimen of this rare and beautiful species was taken in the Garden of the Gods, Colo., July 13.

19. *Cupido Pembina* (Edw.). Golden, Colo., July 3.

20. *Cupido heteronea* (Boisd.). American Fork Cañon, Utah, July 22. It has not before been found east of the Sierra Nevada.

21. *Agriades Podarce* (Feld.). Georgetown, Colo., July 8.

22. *Rusticus Anna* (Edw.). A very poor specimen, but pretty certainly belonging to this species, was taken in American Fork Cañon, Utah, July 22.

23. *Hemiargus Isola* (Reak.). Manitou, Colo., July 15. The only United States localities previously known for this species were Texas and Kansas.

24. *Eurymus Eurytheme* (Boisd.). Denver, Colo., June 27, July 10; Garden of the Gods, July 13; Manitou, July 15–16; Farmington, Utah, July 23; Arapahoe Peak, between 11,000 and 12,000 feet. Very common.

25. *Pontia Protodice* (Boisd.-LeC.). Denver, June 27; Golden, July 3; Georgetown, July 8, abundant; Garden of the Gods, July 13; Salt Lake City, July 21.

26. *Pieris oleracea* (Harr.). This was found very common at Salt Lake City, July 21. The specimens were very clear, with but little dusting of the nervules on the under side.

27. *Jasoniades Daunus* (Boisd.). This was common in Clear Creek Cañon, near Golden, Colo., July 13, at the Garden of the Gods and Manitou, July 16.

28. *Parnassius Smintheus* Doubl.-Hew. Pike's Peak, 8,000 to 9,000 feet, July 14; Manitou, July 16.

29. *Thanaos Persius* Scudd. Georgetown, Colo., July 8. A poor male.

30. *Hesperia tessellata* Scudd. Manitou, July 12–16; Garden of the Gods, July 13.

31. *Pamphila Juba* Scudd. Manitou, July 16. This has not before been found so far east.

32. *Euphyes Metacomet* (Harr.). Manitou, July 16. Previously known from the Rocky Mountains under the name of *Garita* Reak.

33. *Oarisma Hylax* (Edw.). Manitou, July 16.

NOTES ON THE GRAMMAR OF THE NEZ PERCÉS LANGUAGE.

BY REV. GEORGE AINSLIE.

The language spoken by the Nez Percés tribe of Indians is expressed by twenty-five elementary sounds, viz: Eight vowel, four diphthongal, and thirteen consonantal. These are written by twenty-five characters and combinations, as follows:

Alphabet of the Nez Percés language.

VOWELS.

A, a,	as in	all,	hama,	named	awe.
A, *a*,	"	man,	w*a*tu,	"	*a*h.
E, e,	"	prey,	tsekin,	"	aye.
E, *e*,	"	met,	k*e*h,	"	*e*h.
I, i,	"	marine,	im,	"	ee.
O, o,	"	note	tota,	"	owe.
U, u,	"	full,	hu,	"	oo.
U, *u*,	"	tub,	k*u*la,	"	*u*h.
W, w,	"	wine,	wah,	"	we.
Y, y,	"	you,	yoh,	"	ye.

DIPHTHONGS.

Ai, ai,	"	aisle,	aishin,	"	eye.
Au, au,	"	mound,	hautnin,	"	ou.
*E*i, ei,	"	*wanting*,	pel*e*ipel*e*i,	"	*e*i.
Oi, oi,	"	voice,	liloinin,	"	oi.

CONSONANTS.

H, h,	"	home,	hama,	"	he.
K, k,	"	king,	kaua,	"	ke.
L, l,	"	low,	lawit,	"	le.
M, m,	"	mate,	m*a*tu,	"	me.
N, n,	"	not,	nih,	"	ne.
P, p,	"	pear,	pana,	"	pe.
S, s,	"	sun,	silu,	"	see.
T, t,	"	time,	tats,	"	te.
Sh, sh,	"	shine,	ipsush,	"	she.

H, *h*, guttural.
K, *k*, guttural.

The language contains eight parts of speech, viz: Nouns, pronouns, adjectives, verbs, adverbs, conjunctions, prepositions, and interjections.

NOUNS.

Nouns may be classed as common and proper, as in other languages Proper nouns usually express some sentiment; as—

La-la-kol-so-te (the bat that flies by day), Indian name of Lawyer, late head-chief.

Objects as the sun and moon are not designated by different names, the word hisamtuks being applied to both, showing that the language is not affluent in nouns.

Gender.

Only to a very limited extent is distinction of gender expressed as—

hama	man	hatswul	boy
aiot	woman	pitin	girl
pisht	father	askap	brother
pika	mother	kauis	sister

But boar is hama hokhok, man swine; sow is aiot hokhok, woman swine, and so with most of the inferior animals.

Number.

Only a few nouns form the plural.

Some form the plural by repeating the first syllable: as, hama, man; haham, men; hatsw*u*l, boy; hahatsw*u*l, boys; pitin, girl; pipitin, girls.

Other nouns from the plural by prefixing ha; as, aiot, woman; haiot, women; askap, brother; haaskama, brethren.

The plural of names of inferior animals or inanimate objects is expressed by the use of numerals, or the indefinite words tatash, some; ilani, many.

Declension.

Nouns are thus declined:

Nom. hama (man)	Nom. w*a*tash (earth)	Nom. John
Poss. hamanim	Poss. w*a*tashnim	Poss. Johnnim
Ac. hamana	Ac. watāshna	Ac. Johnna

NOTE.—Whenever the thing possessed is in the accusative—as, He teaches John's sons—then the possessive takes the sign of the accusative. Also the nominative often has the termination of the possessive. The vocative case is indicated by the words *a* and kam. The nominative is sometimes written after its verb, and the objective before the verb governing it, but usually the order is otherwise. In this it differs from other Indian languages, as the Choctaw, where both the subject and the object are always before the verb.

Remarks.

Nouns are formed from adjectives; as—

kapskaps	strong	komaits	sick
kapskapsnawit	strength	komaiitswit	sickness

Nouns are formed from verbs; as—

himtaksha	to teach	hipinwash	kitchen
himtakawat	a teacher	tamiasha	to trade
hitaminwash	a school	tamiawat	trader
hipsha	to eat	tamiawash	trading-post
hipt	food		

PRONOUNS.

Pronouns have no gender, only person, number, and case. The third person, *ipi*, is used for he, she, and it. They are declined as follows:

Singular.

I.	THOU.
Nom. in	Nom. im
Poss. inim or innih	Poss. imim or imnih
Qbj. inna	Obj. imana

HE, SHE, or IT.

Nom. ipi Poss. ipnim or ipnimnih Obj. ipna

Plural.

WE.	YE.	THEY.
Nom. nun	Nom. ima	Nom. ima
Poss. nunim	Poss. imamnim	Poss. imamnim
Obj. nuna	Obj. imamna	Obj. imuna

The forms innih, imnih, and ipnimnih are always strictly possessive, representing, respectively, mine, thine, his. But the other form given for the possessive is sometimes found in the nominative; and, as in nouns, the objective form is at times used in the possessive.

RELATIVE PRONOUNS.

WHO.	THAT or WHICH.
Nom. ishi	Nom. kapam
Poss. ishinim	Poss. kapamnim
Obj. ishina	Obj. kapamna
WHO?	THOSE.
Nom. Ishi?	Nom. yokomam
Poss. Ishinim	Obj. yokomuna

ADJECTIVES.

The Nez Percés language differs from other Indian languages, as the Choctaw, &c., the adjective being always placed before the noun; as—

Nez Percés: tats hama (good man).

Choctaw: hatak chukma (man good).

Adjectives do not regularly take degrees of comparison, except that they may be intensified; as—

kapsish, bad; kapsishnihnih, &c.

Adjectives of number are:

naks, 1	winapt, 7	ilaptit, 20
lapit, 2	wimutut, 8	mitaptit, 30
mitat, 3	kuis, 9	wilaksaptit, 60
pilapt, 4	putimt, 10	putaptit, 100
pahat, 5	putimt wah naks, 11	putumisus, 1000
wilaks, 6	putimt wah lapit, 12	

Compare construction with the Choctaw:

NEZ PERCÉS.	CHOCTAW.
1, naks	1, achupa
2, lapit	2, tuklo
3, mitat	3, tuchina
4, pilapt	4, ushta
5, pahat	5, tahlapi
6, wilaks	6, hanali
7, winapt	7, untuklo
8, wimutut	8, untuchina
9, kuis	9, chakali
10, putimt	10, pokoli

As in Nez Percés, *l* and *n* are interchangeable.

NEZ PERCÉS.	CHOCTAW.
6 is winaks, or wi 1	
7 is wilapit, or wi 2	untuklo un, 2
8 is wimitat, or wi 3	untuchina un, 3

Note.

Does it not indicate that five was the original basis of numbers, as ten now is, and that counting was done on the fingers of one hand only?

NOTE.—Many adjectives are double words; as—

k'uts-kuts	little	kaih-kaih	white
pilei-pilei	foolish	ilp-ilp	red
tsimuh-tsimuh	black		

NOTE.—The language is not affluent in adjectives, as, for instance, bitter or sour, they use the same word they do for sweet.

VERBS.

Verbs usually end in *sha* or *tsa*, having the corresponding plurals ending in *shih* or *tsih*. The verb to be is an exception to this rule; as—

wash	I am	hiushih	they were
imwash	thou art	witsatatasha	I shall be
hiwash	he she or it is	hiwitsatatasha	he shall be
num washi	we are	hiwitsatatashih	they shall be
ima washi	ye are	witsatatashaka	I should have been
ima hiwashih	they are	keh waku	if I am
waka	I was	keh huitsaya	if he is
hiwaka	he was		

kusha, to go, is thus conjugated:

kusha	I go	hikushina	they have gone
hikusha	he goes	kutatasha	I will go
kushih	we go	hikutatasha	he will go
hikushih	they go	kutatashih	we will go
hushaka	I went	hikutatashih	they will go
hikushaka	he went	kutatashaka	I would have gone
kushiaka	we went	hikutatashaka	he would have gone
hikushiaka	they went	kutatashiaka	we would have gone
kushana	I have gone	hikutatashiaka	they would have gone
hikushana	he has gone		
kushina	we have gone		

Imperative.

kuih	go singular	wash kutash	I can go or am to go
koot	go plural	ush kutash	he can go or he is to go
kutash	to go		

Compulsive or causative mood.

Nearly all verbs assume a special form to express cause; as—

shapakutatasha	I will be made to go	hishapakutatasha	he will be made to go

shapa, used before or inserted in the verb, expresses this mood.
Verbs also express action as to or from the speaker; as—

inisha	to give	hinigukum	he gives to me
hinisha	he gives		

Verbs also express habit or continuance; as—

hinigukumkinah	he will continue to give to me

NOTE.—Verbs are exceedingly sensitive in regard to number, expressing not only the number of their nominaitive, but also of the objective; as—

hitsa	to say	ima hitsina imuna	they said to them
ima hitsana ipua	they said to him		

Because of this exactness on the part of the verb, pronouns are often omitted.

ADVERBS.

Adverbs do not take degrees of comparison.
When modifying adjectives, they are usually written as a suffix; as—

kutskuts miats	small child	kutskutsanih miats	small very child

Some of the principal adverbs are:

Time.		*Place.*		*Manner.*	
kos	soon	ki	here	kano	at once
kikaua	now	yoh	there	kanóhamtis	quietly
kunku	ever	wyik*u*shlih	everywhere	tats	well
watis	yesterday	akam	above	watu tats	not well
kos watis	to-morrow	anim	below	*aa*	yes
ki mat	when			w*a*tu	no, not

CONJUNCTIONS.

Some of the principal conjunctions are:

kaua } and.
wah }

kaua is used to connect sentences; *wah* usually connects words. When kaua connects words, it is written ka.

tsalui	if	matu	but
huma or atka	because	kumku	therefore

PREPOSITIONS.

Prepositions are never used separate from the nouns to which they stand related. They are always found as suffixes; as—

init	house	inittushkinihkai	on the house
initpa	for the house	initnakaikinihkaikinih	beyond the house
initkinih	from the house		
initp*h*	to the house	initp*h*	in the house
initki	by the house	inithina	with the house

INTERJECTIONS.

Interjections are not abundant.

auwa′ expresses pain;

aaa, approbation, and is used emphatically at the close of an address that pleases them;

kano′, now is your chance;

hamitis′, haste;

mitsimith′, behold.

Lord's Prayer.

Nunim Pisht kam im ,wam aishnawashpa, kam hautnin wanikt
Our Father thou art heaven in, holy (thy) name

wata. Kam miohatowit paina, kam watashpa imanah timiyuna
be kingdom come, earth in thy will (be)

ka kush aishnawashpa iminah timiyutatu. Nuna hipt taksinain
same as heaven in thy will (is). Us to food this day

natsnim; kaua nuna watsatiai nashwaananim, ka kush nun
give; and us to debts forgive the same as we

titokana watsatiai anashwaunaitanih; wat mat tahinawit
people to debts forgive constantly; not temptation

nashtalkakaikukum matu kapsishwiatopkinih natsnakahtukum, atki
lead (us) to, but sin from deliver us because

imim awam miohatowit, imim awam kapskapsnawit, imim awam
thine is kingdom thine is power thine is

sitskeiitswit, kunkuain. Amen.
glory evermore.

NOTE.—"kam" has no equivalent in our language; it denotes that the words are addressed to a person.

Ohertam—*Pinki Vba isht benili ma.*
Our Father above who sitteth.

"ma", like "kam", indicates the vocative case.

Translation of hymn "Just as I am".

Tune: "Home Sweet Home."

Oko keh kush wash saiou wash inanash,
Even so the same I am nothing I am to say

Matiku imim kikat walanca inmain,
Only this thy blood bled me for

Matiku im pimutsam ina imimki
Only this thou bidst come me the to

O Jesus Christ in A *kiyusha wako.*
I yes come have

Kum Kum Kauo Kum.
Come Come at once come

O Jesus Christ in A *kiyukra wako.*

Oko keh kush wash, wah watu sapanmaiki
Even so the same I am and not washing from

Inim wakeswina naks tsimukina
My life one black from

Imimnih kikat shapawalana A.
Thine own blood bled yes.

Sapakaiikas laamua tsimnkna
Wash away will all black

Oka keh kush wash ilatuivin ilatama
Even so the same I am poor blind

Saiδhona kuiswina saikiptona.
Sight wealth medicine for.

Imim timipnia A *oyikulana*
My heart yes everything

In awituasa imimpaitsim yahnash.
I need thee in alone to find.

O Jesus Christ in A *kiyusha wako*
I yes come have

Oko keh kush wash im a inpukum ina
Even so the same I am thou yes receive will me

A liloinakum, A *waunanyukum,*
Yes glad will yes pardon will

Sapakaikokum A *wakas hauiyukum*
Wash will yes life save will

Atka imanah in mitsakuinakaisha.
Because thee in I believe.

Ako keh kush wash imim hatauituam.
Even so the same I am thy love great.

Pakuupsa laamna tiakalkoatona.
Breaks down all fences.

Inim A *imain imtsuiatkain imain*
Thine yes thee alone thine to be alone thee alone

O Jesus Christ in a keyusha wako.
I yes come have.

Kum Kum Kauo Kum.
Come Come at once come.

O Jesus Christ in a kiyusha wako.

NOTES ON THE GEOLOGY OF NORTHEASTERN NEW MEXICO.

By O. St. John.

In the region of the headwaters of the Canadian is embraced a territory which, for the completeness of its geological record and the interest of its concomitant topographical and scenic features, is not excelled perhaps by a similar extent of country in the West. It is bounded on the west by the Spanish range, which in this part of its course consists of a densely-wooded watershed-divide, 9,000 to 11,000 feet in altitude, from which at intervals lofty lateral spurs are thrown off, whose bald summits overtop by 1,000 to 2,000 feet the actual watershed, which latter extends in a general north-south direction. Near the Colorado line, the range is intersected by the Raton Mountains, a range of gladed hills extending eastward forty or fifty miles, and constituting, with the still easterly prolongation in the Chicorica Mesa, the northern limits of the district, which opens out to the southeastward into the great plain. Thus defined, the district comprises an area of about twenty-five hundred square miles.

During the season of 1869, in the progress of his extended reconnaissance of the Rocky Mountains, Dr. Hayden visited this region, from whom we have authentic account of its general geological features, and their intimate relation to those prevailing in other and similar districts to the north and south. A few months' residence in this part of the country in 1874–'75* afforded the writer opportunity to become somewhat familiar with its geological features; and the purpose of the present communication is to present such facts as may tend to contribute something toward a similar knowledge of remote and perhaps hitherto rarely-visited localities, and their connection with already-examined districts.

THE UPPER BASIN OF THE CANADIAN.

In the mountains along the western boundary of the district, many little streams take their rise, which, flowing southeasterly across the great Tertiary plateau, whose surface they score with rugged gorges and beautiful little valleys, finally emerge into the upper basin of the Canadian. This basin forms one of the peculiar and interesting features of the region, and which deserves passing notice, as well on account of its scenic surroundings as the important part it must eventually take when the time arrives for utilizing its thousands of acres of fertile irrigable lands. Among the most important of these tributaries are the Vermejo and the Cimarron; the affluent which retains the designation of the principal stream rising in the plateau, its drainage being entirely derived from the Raton ridge. A short distance below the mouth of the

* It is with peculiar pleasure the writer seizes the opportunity to express his acknowledgments to his friends Messrs. Frank Springer and W. R. Morley: to Mr. Springer he owes the possibility of a pleasant sojourn of several months at Cimarron; and to Mr. Morley he is indebted for valuable data, especially relating to the topography and hypsometry of the country.

latter, the Canadian glides into its great cañon, and thence, far to the south, its channel is said to be walled in by precipitous bluffs of red and variegated sandstone. At the entrance to the cañon, the lowest point in the basin, the stream has an altitude of about 5,700 feet above tide-water. In the distance of forty-five miles direct, or to the confluence of the Rio Mora, the stream has a descent of probably 700 feet, along a part of its course but little known, and, it is believed, as yet unexplored by the geologist. Above the cañon, the stream traverses a broad valley, which gradually slopes from the base of the Tertiary plateau on the west; its eastern border being less uninterruptedly defined by the confused range of volcanic hills and basalt-capped mesas, which rest upon and pierce the sedimentary formations south and east of the Chicorica Mesa, a shallow, triangularly-shaped basin, with an area of about nine hundred square miles, its sharp angle terminating near the southern foot of the Raton Pass, amidst the gorges which mark the western limits of the great basaltic table-land, where the valley reaches near 6,500 feet altitude.

Dr. Hayden has already noted the peculiarities of the basin, attributing its origin to the erosion of the Tertiary lignitic formation, which at a former time doubtless occupied the entire extent of the valley, and stretching far eastward into what is now comprised in the plains, where its ancient border, if at all recognizable, is obscured by superficial accumulations.

Cretaceous.—This upper basin is everywhere underlaid by the Cretaceous, the upper deposits of which here consist of heavy measures of shale, with intercalated thin bands of indurated and calcareous matter, attaining approximately a thickness of 800 to 1,000 feet. These deposits have been recognized as the equivalent of formation No. 4 of the series on the Upper Missouri, and it is to their yielding nature that the gentle slopes and comparatively uniform surface which characterize the basin are attributable.

In the vicinity of the Cimarron, where they exhibit the greatest vertical extent of any single exposure in the abrupt declivity of the Tertiary plateau, underlying the sandstone of that age, they afford a section of above 500 feet, constituting quite half the entire elevation of these border hills. The deposit is here seen to consist of generally dark-blue shales, the upper 190 feet being more of a grayish blue, with little, if any, arenaceous material intermixed. Ninety feet below the base of the Tertiary, concretionary argillo-calcareous masses, generally of small size, are met with, affording fragmentary specimens of *Baculites*, *Inoceramus*, &c.; and 180 to 190 feet from the top occurs a thin band of shale, from which have weathered numerous and beautifully-preserved fossils, characteristic of this period. Below the latter horizon there occurs a rather marked band of large concretionary masses, also containing similar fossils to those mentioned above, below which, however, evidences of life are rarely met with until reaching a horizon some 370 feet below the top; and thence 200 feet lower occasional fossiliferous bands occur, always characterized by the peculiar Cretaceous *facies* of their faunæ.

Between the latter point and the Canadian, twenty-five miles to the east, similar shales apparently compose the bulk of the strata, with, however, as we approach the lower levels, more frequent interpolations of calcareous bands, which often form regular layers of blue argillaceous limestone of a foot or more in thickness. Near Mr. Henry M. Arms's (Loomis's ranch), a few miles above the mouth of the Vermejo, and near the confluence of Crow Creek, one of these thin limestone beds outcrops in the base of a low outlying mound, which affords an

interesting association of Cretaceous forms, consisting of numerous *Inocerami* and *Ostreæ*, besides *Ammonites*, *Scaphites*, *Baculites*, and the fragmentary remains of fishes, representing at least two Teliostean genera and a Squaloid *Galeocerdo*. In the plains east of the Canadian, similar and more extensive limestone deposits are known to occur, which are reported as containing the same faunal assemblage.

Post-Tertiary.—From the base of the abrupt western boundary of the basin, the Cretaceous shales descend in gentle interrupted slopes far out into the valley, and which at one time must have formed a continuous shelving beach-like declivity along the flanking hills. But in the process of the drainage of the basin and the consequent deepening of the channels of the numerous streams which come down from the mountains and neighboring table-lands, this sloping terrace was subjected to extensive erosion, until it now presents the condition of so many terrace-benches descending into the plain between the embouchures of the little valleys. They present all the phenomena of the Terrace epoch, notwithstanding they are wrought out of the Mesozoic deposits, and the mouths of the larger valleys are occupied by series of terraces in all respects resembling in form and position those which, in other parts of the country, are entirely made up of re-arranged drift materials.

The terrace-benches which fill the mouth of the Cimarron Valley may be regarded as typical examples of these formations, in the molding of which the waters of the Cimarron have played an important part. Here there are at least four or five well-defined benches, ranging in height above the present level of the stream from a few feet to 300 feet. The two highest of these benches, which now occupy the divide between the Cimarron and Cimarroncito, are, however, themselves, probably but remnants of the old lacustral beach which once extended continuously along the foot of the Tertiary plateau. The lower and by far the most extensive of these *old* benches attains an elevation of about 200 feet, forming a low mesa extending along the south side of the stream a distance of three miles. Its summit gradually slopes toward the plains, and, like the preceding, is clothed with a thin layer of coarse drift, the degradation of which has thickly strewn the declivities with small bowlders and pebbles, effectually concealing from view the Cretaceous shales upon which it rests. This mesa has been pierced by two or three lateral arroyas, besides the little valley which intervenes between its western extremity and the foot of the Tertiary-capped hills, in the sides of which natural sections of the fossiliferous Cretaceous shales are exposed at various points. The next distinct bench is that which occupies so considerable an area along the south side of the stream, and which drops to the level upon which the town is principally built, though it continues to follow the stream lower down, but much diminished in width. Above the town, this bench reaches the height of 50 to 60 feet, and at a point where its base is washed by the stream an interesting section is exposed, showing the character of the superficial deposits which here deeply cover the terrace. The lower 30 feet or more of the exposure is made up of dark-blue shales of the Cretaceous period. Resting upon these occurs a heavy deposit of modified drift, the lower portion of which is apparently largely composed of sand with streaks of gravel; the upper six or seven feet exhibit a distinct deposit, made up of water-worn bowlders, pebbles, and gravel, which seems to immediately underlie the fine soil with which the terrace is mantled.

Similar exhibitions of terrace-formations, as before stated, are met with in the mouths of all the valleys penetrating the great Tertiary plateau, and perhaps nowhere are more conspicuous and symmetrical

in contour than in the recess into which the Cimarroncito opens out on leaving its picturesque mountain-hemmed valley. Here, in consequence of the rapid pitch of the valley, the terraces have a more marked inclination with the stream than is observed on the Cimarron, and where they present several distinct levels, often isolated, forming low drift-covered mesas or wide slopes rising upon the flank of Urac Mountain.

Besides these more strictly fluviatile formations, in places the borders of the basin are marked by low benches of considerable extent, and which are distinguishable from those occurring immediately along the water-courses by their more level surfaces. Between the Rayado and Cimarron, as also between the streams to the north of the latter, these benches form several levels connected with the main slope flanking the Tertiary plateau, and which are usually distinctly defined by the abrupt descent facing the plain, as shown in the sketch of the Baldy range and that of the Tanaja Mountains. Their tops are covered by a thin sheet of fine drift-material, or the soft Cretaceous shales constitute the subsoil. At other places, limited tracts of barrens are encountered, where deposits of loose sand have accumulated, which the winds mold into ever-varying miniature downs, and whose vegetation, if not peculiar, is distinguished by the prevalence of cacti and those plants which thrive in a sterile soil.

The latter system of terraces probably are more properly referable to an earlier time, when the drainage of the basin was effected; while the modifications resulting in their present conformation is as probably due to the combined erosive action of the Canadian and its numerous affluents, when their volume of waters, issuing from the vast reservoirs in the mountains, was far greater than at the present time.

The nature of the loose materials covering the terraces in the mouths of the valleys plainly indicates the source of their derivation in the mountains to the west, and which were brought down at a period antecedent to the time when the streams had deepened their beds to their present level. The coarser materials and bowlders (the latter generally of small size) largely consist of granitic and gneissic rocks, with a variety of igneous and metamorphic material, whose parent ledges, from which they were torn during the Glacial epoch, are met with in the mountains a few miles distant. But these plains accumulations are insignificant compared with the vast deposits which fill some of the park-like valleys in the heart of the mountains, and which rise high upon the environing declivities.

Besides this comparatively thin sheet of drift-material, the plain is here and there occupied by low buttes and mesas of limited extent, remnants of the Cretaceous shales, the summits of which are often covered by a sort of concrete, consisting of coarse gravel cemented with lime. One of these outcrops occurs on the summit of the elevation near Mr. Arms's, forming a coping to the little mesa upward of three feet in thickness, its presence serving to protect the soft underlying shales from atmospheric erosion. Similar deposits are met on the lower course of the Poñil, a tributary of the Cimarron, where the outcrop appears in the low bluff-banks, at a level possibly not much higher than the exposure on the Canadian just mentioned. It is evident that this concrete deposit is of quite modern origin, but its relations to the drift and late Tertiary deposits are not so clear. It would, however, appear to antedate the drift, the modified strata of which its comparatively limited extent recalls, from the fact of its occurrence on the tops of the outlying remnants of the Cretaceous in the midst of the basin; while it is undoubtedly of much more recent origin than the sandstones at the base of the Lignitic formation, from which it widely differs in the char-

acter and mechanical and chemical aggregation of its components. It would appear highly probable that these deposits prove to be identical n age and origin with similar accumulations observed by Dr. Hayden n the plains bordering the foot-hills in Colorado.

Besides these, the superficial deposits occurring in the basin proper are all referable to the disintegration of the immediately subjacent strata; and these consisting in the main of the soft Cretaceous shales, the soil resulting plainly bears the stamp of its origin in the extremely finely-comminuted condition of its components, and which are in places mixed with a greater or less percentage of arenaceous material derived from the Tertiary formation. This soil supports a fine growth of the peculiar gramma-grass, which affords throughout the year excellent pasturage. The country is already occupied by many enterprising stock-growers, whose herds and flocks roam the broad plains and are counted by thousands. Along the water-courses, wherever water can be easily conveyed by means of acequias for irrigation, the soil produces abundant crops of corn, the cereals, and various vegetables, demonstrating its fertility and the adaptability of the climate for agricultural as well as pastoral pursuits.

Manifestations of igneous phenomena.—Incidental reference has already been made to the basaltic-capped mesas and isolated volcanic cones which constitute the northern and northeastern limits of the basin, and we would here refer to similar deposits and other evidences of comparatively modern igneous activity, which are manifested within the limits immediately under consideration. Forming a natural boundary along the south line of the district, the mesas of Rayado and Gonzalitas extend far out into the plain, above which they rise a thousand feet or more. The great bed of basalt with which their summits are protected once plainly formed an unbroken sheet of igneous matter with that lying immediately to the west, and forming a narrow belt here reclining upon the granitic or metamorphic deposits, which spread over a considerable tract surrounding the Black Mountain group, a section which is intersected by mountain-ridges, marking the denuded crests of gigantic dikes, the evidences of an earlier epoch of igneous activity, a mountain-building epoch in contradistinction to that in which originated the great basaltic mesas, and still later scoriaceous volcanic cones. It is here these modern and ancient products of igneous activity are most intimately associated; the great Chicorica overflow being some fifty miles distant from the igneous manifestations seated in the main range, with the extensive plateau of the Tertiary intervening, which bears no observed evidence of having been involved in the basaltic inundation, the vestiges of which occupy so large a region to the east and south.

While the basin of the Canadian is partially surrounded on two sides by the immense basaltic-capped mesas, the flat summits of which rise 1,000 to 1,500 feet above its surface, the plain itself is everywhere traversed by dikes, the similarity of the components of which would refer them to the same age as that to which belong the enormous overflow in the table-lands. These dikes are of all dimensions, the majority varying in width from 1 to 2 feet, though sometimes much greater, and bearing, if not always, at least in all those at present known, nearly east-west. Their presence and course are plainly discernible by the low ridges of dark basaltic *débris* marking their outcrop in the surface of the plain; in few instances exhibiting rude horizontal crystalline structure, a fine example of which occurs near the southern entrance of the Raton Pass, which has been mentioned by Dr. Hayden. Usually, however, they present an amorphous structure in great variety,

scarcely two dikes having precisely the same mineral constituents and aggregation, though all agreeing in their more or less somber hues. Practically vertical, in several instances a slight northerly inclination from the perpendicular has been noted, while an opposite pitch has not been observed, although such may occur.

These miniature dike exhibitions offer a most interesting field for investigation, both on account of the variety in mineralogical combinations as also the phenomena connected with their occurrence. Although more apparent in the plains where the soft shales have weathered away, leaving the more rugged basalt standing up in long ridges above the surface, strongly contrasting with the prevalent green and drab herbage tints, they are probably equally well represented in the Tertiary plateau. Indeed, in the great slide in the point of bluffs between the Cimarron and Poñil, a small dike may be traced up through the Cretaceous shales into the overlying Tertiary sandstone, where it is lost to view in the *débris* accumulated upon the slope. Mr. Morley has observed in the cañon of the Canadian, in the vicinity of the Raton divide, a similar dike, connected with which he reports most interesting phenomena. The dike is thrust up through the Tertiary strata, and at the locality referred to, it is exposed at a point where it crosses a thin bed of lignite, which it has converted into graphite. The extent of this intense metamorphism was not ascertained; but it is probably limited to a few inches either side of the protruded igneous matter, unless the dike be a large one, in which case its metamorphic action would be proportionately extended laterally. Wherever these protrusions of igneous matter are favorably observed, they are seen to have exerted to a greater or less degree metamorphic action in changing the immediately contiguous strata through which they pass. Thus, in the Cretaceous deposits, the shales are converted into tough slate, the effects of the metamorphism gradually diminishing the farther removed from the originating cause. When the dike crosses a calcareous deposit, the intense heat has had the effect, to a limited extent, of partial calcination, by which whatever organisms it may have contained are obliterated almost past recognition, while the mass of the rock is more or less hardened.

An instance where the lateral extent of metamorphic action may be readily examined occurs in the foot of the little mesa near Mr. Arms's, on the west side of the Canadian. At this locality a couple small dikes protrude above the surface, forming miniature parallel ridges about eighteen yards apart, with a strike nearly east and west. They vary somewhat in width, averaging about fifteen inches, and nearly vertical. At frequent intervals, they are interrupted by abrupt fractures, sometimes resulting in an oblique break; in other instances, the dike is completely dislocated, the overlapping extremities being attenuated, the intervening shale much broken and polished, with slickenside surfaces. The shales otherwise exhibit no indications of disturbance, the igneous matter having been admitted through a simple fracture or parting of the strata. Immediately contiguous to the dike, the shales are much altered, becoming very hard, and showing distinct cleavage-structure, the metamorphic action extending three to five inches either side. The shales are charged with a species of *Inoceramus* and fish-scales, which occur equally abundant in the hard metamorphosed portion.

Perhaps three miles below Cimarron, in the interval between the high terrace-mesa which extends along the north side of the stream, and which is here interrupted by a shallow arroyo, a narrow dike, averaging perhaps two feet in thickness, may be traced upward of three hundred yards in a nearly east-west direction. Its course is less direct or

regular than is usually observed, and near the middle occurs a sort of miniature crater, or "blow-out", as these phenomena are familiarly termed here. The annexed diagram indicates the relation of the crater-vent (*a*) to the main dike. (Plate 43, Fig. 1.)

Here the metamorphism is also very apparent, the shales being changed to slate a distance of twelve to twenty inches either side of the dike.

Following down the arroyo a short distance southward, the low bluffs immediately bordering the north bank of the Cimarron are reached, and which are here capped by a bed of basalt two to four feet thick. This bed seems to conform to the planes of stratification of the Cretaceous shales, which in places overlie the intruded igneous deposit, and which are changed for a few inches in depth above and below. In the main, this bed is quite regular, extending above half a mile in the face of the bluff, at the upper end of which it has been wrought for building-material. But at one point it seems to be connected by a sort of "blow-out" with another and higher bed, which latter occupies a position fifteen to twenty feet higher, outcropping at the surface over a considerable extent, but overlaid by seventy-five feet or more of shales in the mesa at the lower extremity of the bluffs. The igneous matter of these basaltic beds appears to have followed the planes of stratification in the Cretaceous shales, so that their outcrop in the face of the bluff has all the appearances of a sedimentary deposit; and, but for the nature of its composition and the prevalence of minute crystals of quartz, and perhaps one or two zeolites, together with the singular concentration or "blow-out" of molten matter by which some sort of connection is established between the two masses, their true character might be entirely overlooked in a cursory examination. Whether the horizontal fissures have any connection with the beforementioned vertical dike could not be ascertained; but that they owe their origin to some such relationship hardly admits of a doubt.

THE TERTIARY PLATEAU.

Occupying the angle between the main range on the west and the Raton Hills to the north, comprising an area of about six hundred square miles within the borders of New Mexico, occurs the great Lignitic formation of the Tertiary. This formation, in consequence of its vast mineral wealth, consisting of deposits of coal and iron, has received perhaps even more critical examination than has been bestowed upon the older sedimentary formations with which it is associated throughout the region south of the Colorado divide; and the little we may add from the present examinations is rather designed to show its extent in this particular region than further details relating to its stratigraphy.

The eastern border-limits of the formation appear in the line of lofty bluffs which flank the western margin of the basin of the Canadian, extending from the Raton Pass in a southwesterly direction above forty miles to the Cimarroncito; thence stretching northwesterly some ten or fifteen miles to Ute Valley. To the south of the Cimarron River, the formation occupies a narrow belt, where the strata show apparent signs of having participated, at least to a slight degree, in the uplift parallel to the Urac ridge, a spur extending eastward from the Black Mountain group and terminating in the plain between the Cimarroncito and Urac Creeks, forming a lofty granitic barrier 2,000 to 2,500 feet above the plain, and which defines the southern limits of the Raton coal-field.

The rounded condition of the quartz particles in the granitic mass of

the Urac ridge would seem to indicate the mechanical origin of these deposits, though metamorphism has entirely obliterated every other trace of their original character. The same metamorphic action may yet be found to have extended to the more recent formations which rest upon the flank of this great lateral spur. But the Cretaceous, as also the Tertiary beds, have been removed by the erosion of the valley of the Cimarroncito, so that the slope of the granitic ridge is barred, except perhaps insignificant outliers of inclined Cretaceous strata, which have escaped degradation, as if to afford a clew to their former extent and intimate relation to the subordinate axis of upheaval. Indeed, in the low ridge through which the Cimarroncito has cut its lower cañon, and not more than a mile north of the Urac Mountain, the Tertiary sandstones are gently upraised, and bear unmistakable evidences of metamorphism in their semi-quartzose character. Just beyond this point, at the foot of a charming grassy nook, through which the merry little stream winds in the descent of its bowlder-strewn bed, a picturesque escarpment of light granitic rock rises over the stream, forming a craggy battlement along its northern margin. So it would appear that we have already gained the threshold of that old igneous belt which had its seat of origin or culmination in Great Baldy, at the head of the Moreno Valley, twenty miles to the northwest—an outburst of igneous activity similar to, though less marked than, that in which originated the twin cones of the Spanish Peaks, to the north of the Purgatory.

From the eastern flank of Great Baldy northward, the Tertiary deposits follow the somewhat irregular zigzag trend of the main watershed separating the drainage of the Canadian from the basin of the Rio Grande, until reaching the Francisco Pass, at the initial point of the Raton Hills, on the northern boundary of the Territory, or about thirty miles in a direct line nearly due north of Baldy. To the east, the entire country is occupied by the Lignite formation, which is abruptly terminated in the lofty escarpments bounding the valley of the Canadian.

The Raton Hills form a broad-topped ridge, culminating in the watershed between the Purgatory, an affluent of the Arkansas, and the headwaters of the Canadian, and which attains an altitude of between 8,000 and 9,000 feet. From the point where it impinges upon the main range, it stretches nearly due east forty miles, and abruptly terminates amidst the wild ravines and pretty glades at the foot of the basaltic wall capping the Chicorica Mesa, in the neighborhood of the stage-road over the Raton Pass. From a high point near the summit of the pass, at an altitude of near 8,000 feet, the topographical features of the ridge and its relations to the great Tertiary plateau are advantageously displayed. The main divide perceptibly rises to the westward in rounded wooded heights; but to the southwestward files of successively lower undulations or ridges appear, clothed with pine and a variety of dwarfish deciduous growth, marking the courses of the numerous drainage-channels which traverse the plateau from their sources in its western border. Here, too, are observed those conspicuous terrace-like steps which are the records of early shore-lines in the drainage of the ancient waters which occupied the region bordering the eastern flank of the mountains during the epoch preceding our own. These benches—variable in height and distinctness of definition, often forming considerable escarpments or sharp declivities, according to the nature of the deposits, whether arenaceous shales or more consolidated sandstone, out of which they are wrought—constitute interesting features in the topography of the plateau, distinctively peculiar to this formation. Hence it is that when the great eastern escarpment is viewed from a short distance out in the plains, the formation reveals

Creek, looking W.N.W.

th of Potil Cañon.

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only its lower measures, or about half its actual thickness, which probably reaches 1,000 feet in this district. Looking northward, the same formation and conformation prevail, and out of which seem to rise the Spanish Peaks, the Purgatory intervening, but hidden in its valley 2,000 feet below. To the east, the view is arrested in the foreground by the wild intricacy of ravines scoring the Tertiary deposits, above which rears the massive wall of basalt which stretches far to the east and southeast, constituting a blank horizon from its initial extremity in the embattled heights of Fisher's Peak, which frown down upon the valley of the Purgatory.

This great table-land, the Chicorica Mesa, attains an elevation quite equal to the general altitude of the Raton Hills. The somber outlier known as Fisher's Peak may even exceed this altitude; but it plainly sinks away to the southeast and east, and beyond the Trinchera it is no more than 7,000 feet above the sea. Its sides in the southern declivity are gashed by deep ravines, with intervening grassy, terrace-like slopes, underlaid by the Tertiary deposits and strewn with the rough angular fragments fallen from the dark basaltic wall above, which is rarely broken down sufficient to allow easy access to its herbage-clothed summit. It is impossible to examine this great basaltic-capped mesa without being forcibly impressed with the probable important influence it has exerted not only in the origin but preservation of the Raton divide and the Tertiary plateau.

Thus, it will be seen that the Raton Hills in their entire extent are composed of the great Lignitic formation, which abuts upon the metamorphic deposits which flank the main range, probably concealing them from view at the point of impingement in the vicinity of the Francisco Pass. It is along the crest of this divide that these Tertiary deposits also probably maintain their greatest development, and where they may reach a thickness considerably in excess of that just attributed to the formation. When the great escarpment-exposure is examined from the plains at a distance sufficient to afford a comprehensive view of several miles extent, there is observed a marked diminution in the relative vertical in extent of the formation in its extension southward, which, however, does not appear to be a thinning in that direction of the sediments composing its distinct strata, but rather the absence of successive superincumbent beds which have been removed by denudation. This phenomenon is perhaps nowhere more markedly apparent than in comparing the relative elevations of the buttressed heights, which mark the embouchures, like headlands along the coast, of the Canadian, Vermejo, and the Cimarron; and, to obviate the possibility of misconception, the eye can trace the continuity of certain marked horizons in this magnificent outcrop a distance of thirty miles.

The difference in the relative level of the base of the formation at the respective exposures on the Cimarron and the Purgatory would appear to indicate a gentle northeasterly inclination of the strata along the line of this outcrop, amounting perhaps to 700 feet between the above points, or in a distance of about fifty miles. But to the unassisted vision there is no perceptible dip, while the apparent inclination is probably due to the line of outcrop extending obliquely to the descent of the strata from the flanks of the mountains to the west, and possibly also in part attributable to the gentle uplift parallel with the Urac Mountain along the southern borders of the coal-field. It would appear most probable that these deposits have also participated to a greater or less extent in the uplift along the western borders of the field, though it is hardly more certainly apparent than the northerly inclination above alluded to unti'

arriving at the base of the mountains, where, in places, it may yet be demonstrated that these comparatively modern deposits have been suddenly tilted and more or less changed by metamorphism in the upheaval of the great lateral spurs, as instanced in the eastern flank of Great Baldy. In the shallow recesses between the outbursts of igneous activity, which threw up the gigantic masses domineering the range, these beds may extend up to the old metamorphic ridge, upon the flank of which they may rest in comparative undisturbed condition.

The following profile-section (Plate 43, Fig. 2) is introduced to show approximately the superposition of the Tertiary and Cretaceous formations as they appear in the eastern border of the Raton plateau between the Purgatory near Trinidad, and Urac Mountain south of the Cimarron, and the relation of the plateau to the Spanish range.

The heavy line indicates the watershed, the dotted line showing the position of the lofty spurs diverging into the basin of the Rio Grande, the broken line the Baldy range, the lower dotted line showing the upraised western border of the Tertiary at the base of the mountains.

Respecting the mineral wealth entombed in this formation, its deposits of coal and iron have already become famous. Besides the sections alluded to by Dr. Hayden in 1869, and those observed by Dr. LeConte and other gentlemen in different parts of the extensive region occupied by these deposits, we are especially indebted to Mr. Morley, and later to the distinguished Dutch engineer Herr Cornelius De Groot, who has prosecuted special examinations in this direction with the view of developing these resources, and upon whose observations I have mainly relied for the facts relative to the occurrence and aggregate thickness of the coals here met with.

The base of the formation is sharply defined from the immediately subjacent dark-gray shales of the Cretaceous by the sudden introduction of arenaceous material. This primary deposit consists of 20 to 25 feet of thin-bedded dark-brown or rusty ferruginous sandstone, upon which rests a massive bed of light-yellowish sandstone, which latter often forms precipices of 20 to 40 feet vertical. Above this occur alternations of more or less micaceous sandy shales and coarser sandstones, which, in the vicinity of the Cimarron, reach, all told, a thickness upward of 400 feet to the topmost ledges in the neighboring hills.

The same association and succession of strata again appear in the valleys of the Poñil and Vermejo, the latter of which was visited by Dr. Hayden. These sections all indicate the lower portion of the formation as the productive coal-bearing measures. The heaviest bed, which ranges from 4 to 7 feet in thickness, occurs early, though probably preceded by one or two minor carbonaceous horizons. Thus, near Mr. John Dawson's estate, at the mouth of the Vermejo Valley, the section exhibits seven beds of coal, of an aggregate thickness of 22 feet, included in about 160 feet vertical thickness of strata. At the base of this section occurs a heavy deposit of excellent coal, which is little more than 7 feet in thickness; 13 feet above this occurs a bed about 4½ feet thick, separated by thin partings; and 40 and 20 feet respectively still higher a couple of 3-foot beds of coal are met with, the intervening strata consisting of slightly arenaceous shales, above which three 18-inch beds are found in a vertical thickness of about 65 feet.

The fine under- and roof-clays associated with some of these coals often contain vegetable remains, but which generally so readily crumble on coming in contact with the air as to render it exceedingly difficult to secure specimens. Higher in the series, the sandstones afford the usual vegetable representatives peculiar to the formation, amongst which nota-

Plate 43

Fig. 1.

Fig. 2

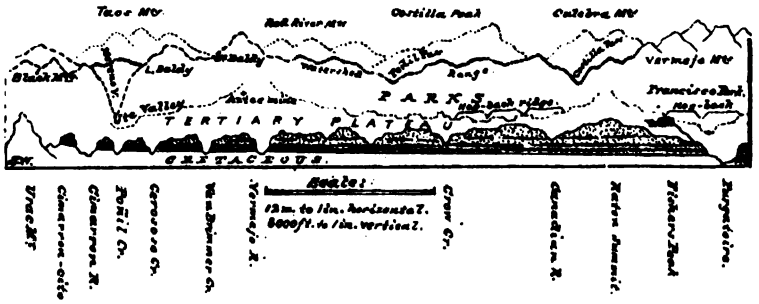
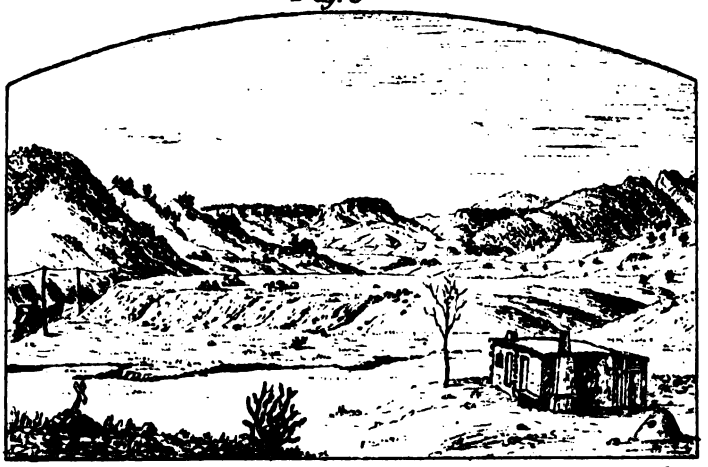


Fig. 3



Urac Mountain and Urac Mesa, from Cimarron; looking S.S.W. Low mesa hills in foreground and at foot of Urac Mt., composed of Cretaceous shales (No. 4), and, like the low terrace, covered with a thin sheet of drift.

bly are the palms and broad linear sedge-like leaves. But in this particular, the region is almost absolutely unexplored, and what careful research would here reveal, we might be justified in entertaining extravagant conjectures from the results attending the more detailed explorations of the fossil flora in other quarters.

THE MORENO VALLEY.

The mouth of the Cimarron Valley rapidly narrows, and some three miles above the town the border-hills converge, confining the stream to a narrow gorge-like valley, which becomes narrower and more rugged as we ascend, and hemmed in by precipitous walls of Tertiary sandstone and steep slopes descending to the margin of the water. The valley, or lower cañon, has a northwesterly course, and an average gradient throughout of about 75 feet to the mile. Perhaps four or five miles above its mouth, the last exposure of the Cretaceous shales, which hitherto outcrop in the foot of the hills, appears in the north bank of the stream, where they show a thickness of about 50 feet, reaching from the water's edge to the demarkation of the apparently not unconformable Tertiary deposits. The latter here consist, at base, of indurated arenaceous shales, light yellowish or buff in color. At this point, the road follows the south side of the stream, and a rise, to avoid a narrow, rock-bound gorge, takes us above the Cretaceous, before regaining the stream, a few hundred yards above the exposure.

Thence to Ute Valley, six or seven miles, the entire height of the inclosing walls of the valley is composed of the Tertiary sandstone, great blocks of which are scattered over the less abrupt declivities or piled into the bed of the stream. Just before emerging into Ute Valley, through rifts in the pine- and spruce-forests, a glimpse of the park-like opening is gained; the long crest of Little Baldy, broken down to the south in the deep gorge through which the upper cañon lies, filling the background framed between the steep Tertiary walls which hem in the foot of the valley.

This little valley is the southernmost in this district of a chain of similar parks extending along the flank of the metamorphic belt at the base of the main range, and which reach far to the north into Colorado. Its southern or short side is bounded by the steep granitic slopes which descend to the south margin of the intervale-bordered Cimarron, and thence the open, terraced plain rapidly rises to the northwest, as it approaches the source of Ute Creek in Great Baldy, which lies at the head of the valley, or some eight miles from its foot. The low, flat-topped Tertiary hills form the eastern border of the valley, the sandstone showing a slight dip in that direction. To the west lie the rugged granitic foot-hills, which rise in extensive "flats" up into the ridge extending southward from Great Baldy, and which just peers above timber-line in the crest of Little Baldy Mountain. It is very probable that the more or less metamorphosed and tilted Cretaceous and Tertiary formations intervene and rise up on the lower flank of these mountain-elevations. The mountains are intersected by pretty open glades, or "flats", affording pasturage for the stock belonging to the farms in the valley, which latter contains an area of about three thousand acres, much of which is adapted to agricultural purposes.

Along the Cimarron, the valley has an altitude of about 7,200 feet; the rise to its head, in a distance of five or six miles, probably reaching above 8,000 feet. Throughout its course, gold is distributed in the superficial deposits, and which is now being mined in the upper portion

of the valley. The placers are mainly worked in the immediate vicinity of the stream, whose waters are husbanded with greatest care. At one of the lower mines, to which we were conducted by Mr. Keep, an old and experienced miner, we had opportunity to examine the nature of the "bed-rock", which had been laid bare over several square yards' extent. Here it is composed of the partially-metamorphosed dark shales of the Cretaceous, containing *Inoceramus*, &c., which dip to the northeast at an angle of about 30°. The slaty shales were nowhere planed smooth, their ragged upturned edges presenting innumerable "riffles", between which the gold is lodged. Some of these "rims" afford very rich "pay-streaks", and the entire surface, after having been laid bare by the ground-sluice or hydraulic, both of which methods are here in operation, is carefully gleaned for the auriferous earth. It is said that the sources of these precious particles are readily recognized, the wire-gold having been derived from the celebrated Aztec lode, while the finer scales come from the Montezuma lode, the parent ledges which outcrop in the eastern or southeastern flank of Great Baldy.

Ascending Ute Creek some eight miles above its confluence with the Cimarron, on either side of one of the steep gulches with which Great Baldy is furrowed, are found the mines opened upon the Montezuma and Aztec lodes. The former lode has a strike little north of east and south of west, and along its discovered course it traverses a porphyritic rock, such as apparently constitutes a great bulk of the eastern declivity of the mountain. The Aztec, which is opened in the north side of the ravine, about a mile distant, runs in a northwesterly and southeasterly direction. At one of the lower galleries, which is being driven into the hill with the view of penetrating to the lode, opportunity was offered for observing the character of the deposits penetrated a distance of 100 feet or thereabouts. The gallery penetrates the hill in a northeasterly direction, probably nearly at right angles to the strike of the sedimentary deposits, and in the direction of their dip. At the entrance, and extending several yards along the gallery, occurs a considerable thickness of dark Cretaceous scales, which are changed to a brittle slate by partial metamorphism, in which have been observed *Inoceramus*, *Ammonites*, &c. Then the excavation encounters a dark-gray quartzose rock, the end of the gallery having reached a crevice, which was charged with pyrite and fragments of partially-changed bituminous material. The slaty shales at the entrance of the gallery are unquestionably Cretaceous, and it seems reasonable to infer that the quartzose rock may be referable to the Tertiary formation, or the highly-metamorphosed sandstone occurring at its base; the changed bituminous seam representing one of the thin lower lignite beds, such as are known to exist just above the heavy-bedded inferior sandstone.

The mines are opened at an elevation of about 9,500 feet above the sea, thus showing that the Cretaceous shales have been tilted in the upheaval of the Baldy range at least 3,000 feet above the level they occupy in the borders of the plain at the mouth of the Cimarron Valley. In the passage of the trail over the Blackhorse Pass, which diagonally ascends the eastern declivity of the mountain to the saddle between Great and Little Baldy for perhaps a distance of nearly a mile, rusty-weathered fragments of porphyritic rock, apparently identical with that inclosing the Montezuma lode, are met with, completely strewing the surface. Above this nearly to the summit, a distance of half a mile, the mountain-side is equally thickly covered with large and small angular fragments of a schistose rock, the composition of which closely resembles the quartzose ledge noticed in the Aztec tunnel; and higher still

[illegible]on;
[illegible]

[illegible]th of
[illegible]

immense quantities of similar fragments of bluish-gray, laminated, exceedingly brittle, slate-like rock, showing cleavage-structure. That these uppermost belts represent sedimentary deposits which have been converted into true metamorphic rocks seems highly probable; but whether they pertain to the Cretaceous and Tertiary, or represent still more ancient formations, remains to be determined.

At the time we crossed the pass, a considerable snow-field lay upon the summit, concealing the nature of the deposits immediately in the crest. From this elevated outlook, which attains an altitude of about 11,000 feet, a magnificent view is gained, overlooking the country to the eastward. The dark, fir-clad slopes rapidly descend into the little valley which lies at the foot of the mountain, beyond which the great Tertiary plateau extends, gashed by the lower cañon of the Cimarron; and nearly twenty miles away we distinctly descry the white walls of the little town nestled in the mouth of the valley on the border of the plains, which stretch to the distant horizon sixty to one hundred miles away. The Urac ridge and the great plateau appear diminutive and tame; but far away to the northeast the horizon is broken by the mesas and volcanic cones in the region of the Capulin, the beautiful plain of the Canadian intervening. To the west, a large extent of the Moreno Valley is commanded, bounded by a range of low, wooded mountains on the farther side, beyond which the massive snow-clad domes of the Taos Mountains rise far above the timber-line. Away to the northwest, in the midst of the Red River Mountains, great white escarpments are visible, constituting a conspicuous landmark, the character of which was not ascertained.

Returning to the foot of Ute Valley, a short distance above the toll-gate, a low comb of light, columnar, granitic rock rises out of the plain to the height of about 50 feet, presenting a mural face to the south: it would appear to be the remnant of a dike, and may have some connection with the ridge on the opposite side of the Cimarron, which rises 300 feet or more above the intervale. From this point, the valley narrows, and two and a half miles above its eastern or lower angle the stream emerges from the upper cañon, the mouth of which is flanked by masses of more or less metamorphosed sandstone, probably of Tertiary age. But a few yards farther on, ledges of light-gray granitic rock, similar to that mentioned above, and strikingly like that composing the hump in the Urac ridge, again appear, as though thrust up through the sandstone, which latter is again met with. But very soon the granitic ledges recur, which now seem to predominate, and two or three miles within the cañon it becomes the prevailing rock, although occasional sandstone bowlders are observed some distance higher up.

The upper cañon of the Cimarron is one of the most interesting mountain-defiles in the West, which has been made accessible by an excellently-constructed wagon-road. Hemmed in by high mountains and enormous inclines, abounding in dizzy precipices and picturesque crags, with a wealth of strange and beautiful vegetable forms, and traversed by the changeable mountain-stream, here a mad torrent and now a murmuring brook eddying along a brief level, refreshed at intervals by incoming contributions of purest water from sources hidden deep in the surrounding fastnesses: what it must appear in midsummer, when its vegetation is at the height of perfection, its yuccas and cactuses crowned with rich and gorgeous blossoms, its rocks and shrubs overrun with beautiful creepers and climbers, and its nooks of fresh turf smiling with tiny varied-hued flowers, we may only venture to conjecture. But its autumn raiment of deep greens, rich browns, and brilliant yellows,

and its spring habit of russet, soft grays, and emerald, together with a sky inimitable and as varied as the seasons, are as fertile in promise as sufficient in contrasts.

The cañon has a general westerly direction, and is some eight miles in length. About midway, a chain of lofty granitic escarpments borders the north side of the stream, along which they extend nearly a mile in truly Gothic grandeur. The lower mass occupies an angle in the cañon, and viewed from below it may be imagined to bear striking resemblance to a cathedral-pile. The upper cliffs form a sort of amphitheater extending several hundred yards along the stream, and whose pierced and pinnacled heights rise 500 or 600 feet above the water in a sheer precipice, the face of which is vertically ribbed by the tendency of the rock to assume a columnar structure; however, in places it is solid, clustering in monumental groups in the steep declivities, or towering like castellated ruins in some promontory overlooking the gorge.

Toward the upper end of the cliffs, a huge bowlder-like mass of dark-green stone protrudes like an enormous excrescence from their base, and which continues along the north side of the stream about one-fourth of a mile. It then loses its distinctive character, and thence appears like trap of various shades of dark brown and green, which may be traced two or three miles up the cañon. This gigantic dike is traversed at various angles by fractures, which have been filled with various mineral substances, as black trap, quartz, &c.

This portion of the cañon is frequently bordered by immense inclines, descending from heights of a thousand feet or more, and composed of the angular *débris* resulting from the atmospheric degradation of igneous ledges seated high up in the mountain-sides. These talus-slopes are sometimes quite destitute of vegetation, though generally sparsely grassed over and covered with pines, spruce, and cedar. The latter, with a sparser representation of the piñon at this elevation (8,000 feet), generally prevails in northern declivities, the pine and spruce occupying the opposite and more exposed slopes. Even here the dwarf-oak is met with; but the prevalence of the quaking-asp, which forms thickets beside the stream and high up in the adjacent mountains, plainly indicates the altitude, as also does the occurrence of dense tracts of spruce.

Just before reaching Macelroy Creek, by which an old trail gains the Moreno Valley, a ledge of red feldspathic granite outcrops in the north side of the cañon, and a short distance above detached masses of gray syenitic rock were observed. A few hundred yards above Macelroy Creek, and perhaps a mile and a quarter from the upper entrance of the cañon, in a high ridge, round which the stream makes a sharp curve, a reddish contorto-laminated gneiss occurs, and which also appears in the little valley of Macelroy Creek. This rock continues thence nearly to the Moreno Valley, apparently constituting an immense thickness, perhaps interbedded with micaceous schists, and succeeded on the west by a very hard red quartzose rock. These deposits appear to constitute the high hills along the east border of the Moreno Valley (at least in the neighborhood of the entrance of the Cimarron Cañon), and may possibly also be found in Little Baldy. Similar rocks are said to occur in the summit of Great Baldy, although none such were observed in the saddle over which the Blackhorse trail passes.

The Moreno Valley extends in a north–south direction nearly eighteen miles, with an average width of two miles. It properly does not belong to the system of shallow park-basins which were excavated out of the Cretaceous and Tertiary formations, and to which Ute Valley belongs; but it rather pertains to the possibly older lake-basins, environed by the

Raton Hills. Fishers Peak. Eastward from Costilla Pass. Tertiary Plateau Chicorica Mesa. Copulin region.

metamorphic and granitic ranges to which the great parks of Colorado belong, of which it is a diminutive representative in this southern region. The valley is drained by the Moreno and Cienegilla Creeks, which unite to form the Cimarron at the portal of the upper cañon, where it breaks through the eastern rim of the valley a little to the north of its middle, at which point it has an altitude of about 8,100 feet. To the south, far up the course of the Cienegilla, a broad vega, or meadow-intervale, extends; but to the north, along the Moreno Creek, the bottom-land rapidly narrows, and before reaching Elizabethtown, seven miles above its confluence, the stream is confined within a narrow valley between the slopes reaching down from Great Baldy and an outlying rocky hill on the west side. Above the town, the upper course of the stream is bordered by beautiful undulating pasture-lands, surrounded by an amphitheater of low wooded hills, which culminate in Great Baldy, four miles to the eastward, whose bare rounded dome looks down from a height of 3,500 feet upon the town, or 12,100 feet above the sea.

Throughout the main valley, more or less distinct terrace-levels gradually rise into the surrounding hills, forming broad, grassy benches, cut at intervals by the little affluents which descend to join the main streams. These benches are apparently made up of drift-material derived from the neighboring mountains, whose flanks are buried beneath a vast accumulation of *débris*, forming in localities high, rounded foothills flanking the mountains, and which are grassed over, with here and there groves of pine standing upon some outlying rocky point. The wide intervale which occupies so considerable a portion of the valley immediately adjacent the principal streams is furnished with a rich, dark, loamy soil, which produces an abundance of wild hay and bountiful harvests of all the hardier cultivated crops. The snows which fall during winter, and the copious showers occurring during the rainy season, which latter sets in the latter part of May, afford ample moisture. The autumn months, and indeed far into winter, are dry and incomparably pleasant. Even the winter and early spring, with their occasional severe snow-storms, are generally open, so that cattle gain their own subsistence the greater portion of the season.

Limited areas in the lower portions of the bottom-lands are wet and boggy early in the season, and here is occasionally observed a white efflorescence, similar to that occurring in the plains. Peaty deposits are also met with in the adjacent slopes, or wherever springs issue. A notable instance of such a formation may be seen at Mr. Pascoe's, near the entrance of the Cimarron Cañon. The subsoil, however, throughout the lower level consists of the finer materials of the drift, which have accumulated in the bed of the ancient lake which once occupied the entire valley. As we approach the heads of the valley, as also its border-slopes, the drift increases in coarseness, where its character has been partially exposed to view in the operations of placer-mining.

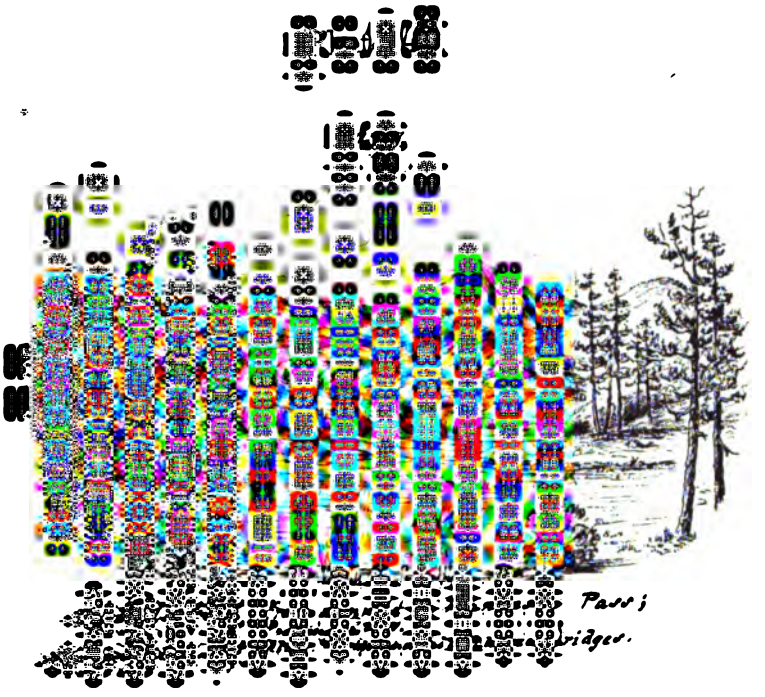
There would appear to be little doubt but that a vast quantity of the loose materials which were swept down into the basin from the neighboring heights during the Glacial epoch have been subsequently drawn off in the drainage effected through the Cimarron Cañon, in the mouth of which they were redeposited upon the old lacustral benches bordering the Canadian basin, and in the terraces fashioned by the waters of the Cimarron itself. But of the deposits observed to-day, it is difficult often to decide how much is due to the ancient and the extent of subsequent modifying agencies, continued even to the present time, in building up and adding to the superficial deposits, especially those accumulations occurring along the sides of the valley. In the rather high bench on

the east side of the Moreno, upon which Willow Gulch embouches, the part performed by the little tributary up to a very recent date is plainly indicated by the long train of *débris* which its floods have swept out into the valley, like the tailings of some immense placer-washing.

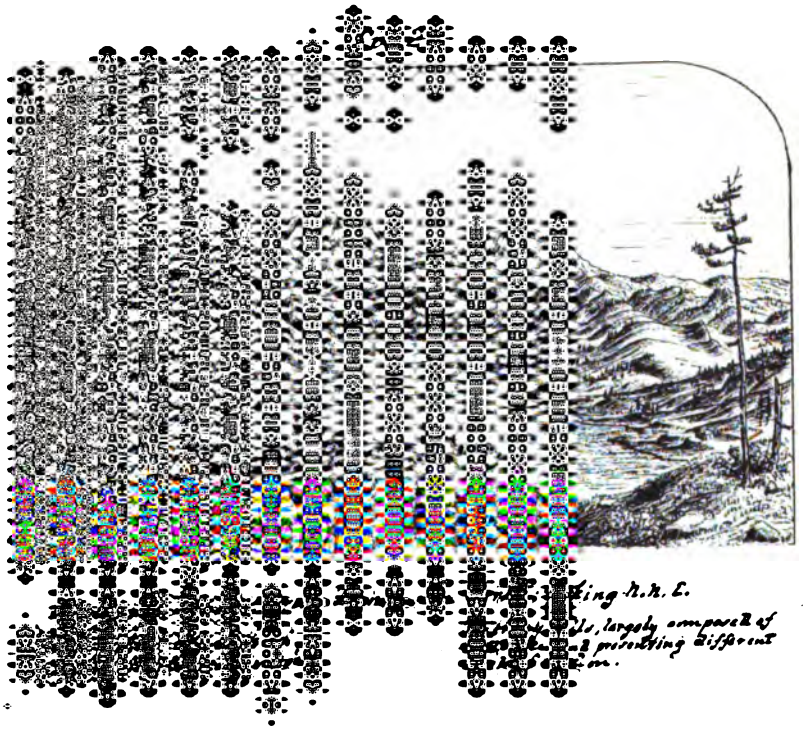
Some ten miles across from the Cimarron Cañon, in a southwesterly direction, a well-constructed Government road leads to the summit of Taos Pass, by which exit communication is gained with the valley of the Rio Grande. The watershed, which is a comparatively low divide, along its course bounding the Moreno Valley, is here broken down, affording a passage in elevation above the level of the sea about 8,850 feet. The pass lies over a narrow ridge, with rather sharp descents on either side for a short distance, when its approaches are so gradual as scarcely to give a premonition of proximity to one of the great natural highways across the Spanish range. On the summit are observed fragments of partially-metamorphosed reddish sandstone, together with other erratic masses. Looking off to the east, a part of the Moreno Valley is overlooked, and just beyond rise the mountain-masses on the east side of the valley. These consist of immense broad-based, low-crowned summits, dark with tracts of spruce-forests, amidst which are scattered extensive mountain-meadows and groves of aspen, which lessen their otherwise somber, monotonous aspect. These hills forcibly remind one of the broad-crested mountain-range which traverses Vermont and Western Massachusetts; a resemblance which will probably be found to possess even closer relationship in the similarity of geological structure.

It affords me much satisfaction to be permitted to announce in this place the discovery, by my friend Mr. Frank Springer, of Carboniferous strata *in situ* in the Taos Cañon, on the western declivity of the main range. On a recent journey (April) across the range to Taos, Mr. Springer was struck by the familiar appearance of certain deposits along the hemmed-in valley down which the Government road passes from Taos Pass, and, dismounting to prosecute a hasty examination, he found himself in the midst of a rich fauna, the *facies* of which indicate the most intimate relationship of the strata in which it occurs to the Upper Coal-Measure deposits in the region of the Lower Missouri. Among the forms recognized by Mr. Springer are *Spirifer cameratus*, *Athyris subtilita*, *Retzia Mormonii*, several species of *Productus*, and numerous Crinoidal remains. The fossils are associated in a dark calcareous shale, which extends from the lowest outcrop examined, at a point some eight miles from Taos, up the cañon several miles. The strata bear evident indications of great disturbance, being tilted in various directions, and which apparently exist in considerable thickness. The discovery of these beds affords ample confirmation of the suppositions expressed by Dr. Hayden in 1869 that the Carboniferous and older Palæozoic formations "once existed all along the western side of the mountains".

On the upper course of the Moreno, in the vicinity of Elizabethtown, is situated one of the famous mining-centers of the Territory. The auriferous lodes intersecting Great Baldy have squandered their wealth, distributing it in the beds of the gulches furrowing its sides, and which the denuding agencies have transported far down into the neighboring valleys. In former years, vast mining-schemes were projected, and large sums expended in carrying them out; but to-day, if the operations are less stupendous, they are certainly conducted in a most thorough and systematic manner. In the lower course of Grouse Gulch, Messrs. Lowhian and Middleton are working an extensive placer-claim, by the



Pass;
ridges.



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hydraulic method, with most satisfactory results. At the time this mine was visted (May, 1875), the entire width of the bed of the gulch, 200 to 300 feet, was being worked, the breast of variable height, 10 to 20 feet. Here was afforded an excellent opportunity to examine the character of the superficial deposits, which are exceedingly variable both in the fineness of their components and their distribution in irregular layers. The coarse materials, pebbles and bowlders, are rounded by abrasion, coarser and finer interstratified, often inclosing "pockets" filled with gravel, and all resting upon the so-called "bed-rock". The latter consists of partially-indurated, tenacious, red clay of considerable though variable depth, and which in turn rests upon the true bed-rock, which is here a coarse-textured, light or grayish, granitic rock, very like that occurring in the opposite or southeastern flank of Great Baldy. This rock is exposed at one or two places near the foot of the claim, and where much weathered it was slightly iron-stained red. The indurated red clay, which it is said is met with in nearly all the gulches on this side of Baldy, may have resulted from the disintegration of this rock.*

Very similar rock crops out in low ragged ridges or "rims" on the west side of the Moreno opposite Grouse Gulch, above and below Elizabethtown. The red clay is said to contain gold, but its exceeding tenacity prevents the working of only the upper portion, in which rich "pay-streaks" are encountered. The mining-season lasts about five months, beginning in May. The supply of "free" water, which is collected in private reservoirs during the winter and early spring, lasts four to six weeks, when the supply is drawn from the big ditch, a canal deriving its waters from springs at the source of Red River on the west side of the watershed, and, circumventing the head of the Moreno, is carried high up on the flank of Great Baldy, terminating near the head of Grouse Gulch. A single season's expense for water drawn from this source in working this mine amounted to $5,000. The results of a season's operations at the "cleaning up" indicated an average of about one dollar per cubic yard; it is claimed that the mine can be profitably worked for one-tenth the yield above recorded per cubic yard. Other placer-mines are being worked on this side of the mountain, though none quite as extensively as the claim above noticed.

Passing up the grassy hill-side which rapidly ascends from the Moreno, and which is gashed by the unsightly washes of sluices and accidental breaks from the several supply-ditches which have been carried round the mountain, we gain a wooded shoulder perhaps a thousand feet above the town, and are fairly set out on the trail to the head of Willow Creek and the Blackhorse Pass. The way traverses a steep wooded declivity on the southwest flank of Baldy, part of the way alongside the Moreno ditch, which terminates near here and gradually ascends to the elevated flats in the vicinity of the head of Willow Gulch, which were once populous with mining-camps, as the numerous deserted log-cabins on evey hand attest. The mountain-side is perforated with prospect excavations, treacherous pit-falls to the unwary horseman, and stripped of its once fine forests, either for the use of the mines or destroyed by the fires. Placer-mining obliterates whatever attractiveness a locality may have originally possessed, and these once wild picturesque ravines and high aspen-fringed mountain-glades are not only

* It is strikingly analogous to some of the deposits resulting from the still (so to speak) disintegration observed in the Brazilian mountains, where the process may be examined in all its various stages, from the unchanged granitic and gneissose native ledges up into the thoroughly-comminuted red paste, with its overspreading sheet of drift at the surface.

desolated but forbidding spots, even whose crystal waters are turned to mud, desecrated by the prosaic results of the search for treasure.

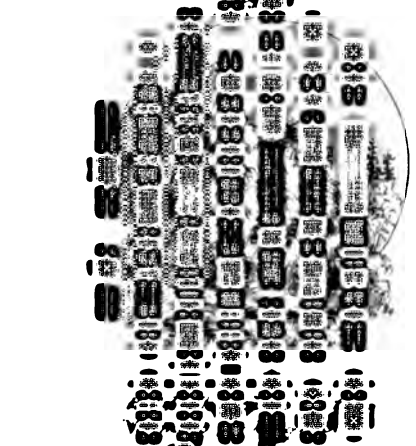
Along Willow Gulch, which is here a narrow defile bordered by steep acclivities, the placers are still being worked to the extent of the water-supply. One is struck with the vast quantities of coarse materials predominating in the drift *débris* of this high mountain-gulch. However, in some of the shallower lateral ravines, finer deposits are observed, and at one point, during the winter, tunnels were drifted into the bank along or in quest of pay-streaks upon the "bed-rock". The climb of half a mile or so out of the gulch, by a trail sufficiently precipitous for practicable traveling, and the summit of Blackhorse Pass is gained, nearly six miles by the route due east of Elizabethtown. The crest of the saddle, now bare, was formerly clothed with a dense forest of small spruce, whose naked blanched trunks, prostrated by the fierce gales that sweep the summit, form formidable abatis over extensive tracts of the mountain-side, with here and there clumps of bare poles still standing, weird evidences of the devastation wrought by the fires.

THE VERMEJO PARKS.

In October, 1874, I was favored with the opportunity of joining a party of gentlemen on a week's hunting and pleasure excursion to the interesting region of the sources of the Vermejo, in the northwestern portion of the district under consideration. Our route led up the valley of the Van Brimmer, the entrance of which is reached some twelve miles to the northward of the Cimarron, passing on the way the Poñil and Cerososo, up whose valleys we have a distant view of the long ridge of Costilla Peak. The entrance to this little valley seems to foreshadow at the outset its character throughout, a promise which is fully verified.

It can hardly with propriety be termed a cañon, although its lower course and intervals above are bordered by the high bluffs of the Tertiary formation, from the base of which a talus over the Cretaceous shales sweeps down into the valley for a short distance above its embouchure. The greater extent of the valley lies entirely in the Tertiary deposits, as is the case with all the streams intersecting the great plateau; but the Van Brimmer may be distinguished from the others by the mild expression, so to speak, of its topographical features, and which render it a favorite route to the park country. Rising just on the edge of the park at its head, it would appear to have been less actively engaged in the drainage of the chain of old reservoirs than many of its companion streams; consequently, acting the office of a quiet waste-escape for the waters which flowed over the barrier at its head, its bed exhibits scarcely any of those bold features which are attributable to violent erosive action. Indeed, for a distance of several miles its bed and surroundings become almost monotonous from their repetition every mile of the way, presenting a shallow trough gently flaring up into the bolder acclivities which hem in the valley, but which is redeemed by those accessories which nature so effectively employs in embellishing alike the level plains and rugged hills. The pine- and piñon-covered heights form a pleasing contrast with the light shades of the close herbage carpeting the lower depressions, relieved on the steeper slopes by patches of the rich-hued autumn foliage of the dwarf-oak, designs excelling the most beautiful tapestries, which seem to have been conceived in imitation of these natural patterns so prevalent in the valleys and on the mountains of New Mexico and Colorado.

About midway of the valley, the hills approach from the opposite



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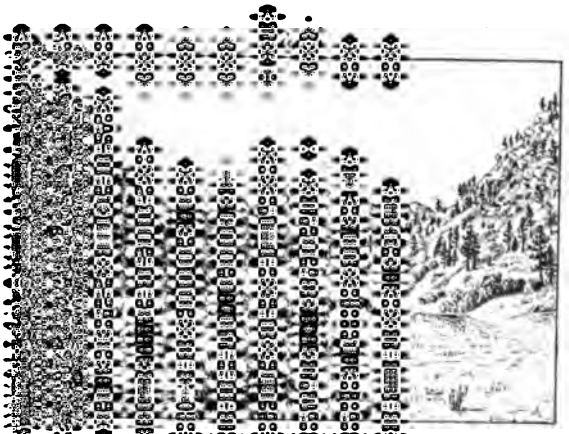


N.W., up
of park 3 miles
on the Vermejo.

sides, interrupting the sameness by a low range of highlands, through which the stream has cut a veritable cañon in miniature. This sandstone barrier forms rather the sudden limits of a horizon of the Tertiary formation, possibly indicating a shore-line of the earlier stages of the drainage and erosive action which finally resulted in the present configuration of the country. Below this point, in the north side of the valley, a group of curious little monument formations are noticed, which recall those to which Monument Park in Colorado owes its peculiarity; only these are fashioned out of the clayey *débris* resulting from the disintegration of the arenaceous deposits of the adjacent Tertiary, their tops capped by fragments of sandstone detached from higher ledges, and which have retarded their demolition by the elements, reproducing, on a smaller scale, the same phenomena witnessed in the fantastic shapes which cluster in the acclivities of the little park at the base of Pike's Peak.

Above the gateway, the valley again widens, and, as we advance, beautiful glade-like depressions open charming vistas into the neighboring uplands. Soon, to the westward, a range of low mountains files across the gap in the distance, their rounded summits and declivities covered with evergreen forests and great plats of yellow-leafed aspen; this is the watershed which preserves the continuity of the Spanish range in the diminished altitude and bulk of its extension southward, and which is here 10,000 to 11,000 feet above the sea. At the heads of the Poñil and the north branch of the Vermejo, the divide sags, opening passes 9,600 and 9,500 feet in altitude, and which are perhaps the lowest in the range north of the Taos Pass.

Leaving the bed of the stream to the left, the trail rises a low upland, and, in a short distance, gains the park-like basin at the head of the valley, in which also rises an affluent of the south branch of the Vermejo. The eastern rim is quite low at this point, which either indicates a very shallow basin or the comparatively limited extent of its area drained by the Van Brimmer. A slight descent leads to the borders of a little pond, near the margin of which highly ferruginous ledges outcrop, and quantities of limonite nodules are scattered over the surface. The evaporation of the water has left it margined by a shelving beach, which is whitened by an efflorescence which renders the water unpalatable, although the flocks which are pastured here are said to relish both the water and the saline-impregnated earth. This point, which is some twenty-five miles from the lower entrance of the valley, has an altitude of about 8,000 feet. Clumps of pine—many of which are girdled by the Utes in quest of condiments for their pottages—are scattered over the park, the undulating surface of which is broken by low, flat-topped hills or ridges, which are apparently composed of Tertiary sandstone and shales. To the west, southwest, and northwest lies the wooded crest of the main range, in the direction of which the park country becomes more and more diversified on approaching the outlying ridges of tilted sedimentary deposits reclining upon its flanks.

Our route passes along the eastern edge of the basin, in a direction a little west of north, amidst varied local scenery and glimpses of sublime mountain views. Twelve or fourteen miles from the lakelet, at the head of the Van Brimmer, we reach the main or north branch of the Vermejo, at a point just above the gorge by which it makes its exit from the park, and where the altitude is about 7,700 feet. About midway between the above points, a diminutive tributary of the south branch winds through an extensive level vega-tract, which is surrounded by low mesas and ridges, between which communication is had with other basins by pretty

little grassy valleys. From the acclivity on the southeast side of this meadow-basin, looking toward the northwest, a magnificent view of the range is gained, beginning in the rounded contours of the lower divide to the south of Costilla Pass, and sweeping thence round into the north-northwest, where it culminates in the lofty peaks of the Vermejo Mountains. A little to the south of northwest, the snow-clad summits of the Culebra Mountains just appear in a low depression in the watershed; to the south of which, and occupying a re-entering angle in the watershed to the westward, the Costilla Peak is seen in profile, a massive ridge gradually culminating in a lofty cone, which appears to be suddenly broken down to the northward in a nearly vertical wall of a thousand feet or more. To the northward, and extending eastward across the open space, lies the comparatively low ridge of the Raton Hills, flanked by mesa-like ridges, which form a marked barrier along the east margin of the park-basin. In the foreground, a long line of table-topped Tertiary hills hide from view the "hog-back" ridges which lie parallel to the range. These low mesa-hills constitute a marked characteristic in the topography of the parks. They are apparently made up of arenaceous shales and sandstones, in quite horizontal position, and of various levels, as though they owe their configuration to aqueous denudation. Indeed, these low table-hills present the same contours, though on a much diminished scale, which prevail in the great escarpment-outcrop bordering the basin of the Canadian, in which a thousand feet thickness of the Tertiary and Upper Cretaceous deposits are revealed. In their declivities are occasionally encountered monumental outliers of sandstone, and it seems not improbable the region may prove fertile in these lesser and singular freaks of atmospheric denudation.

The pebbles and bowlders, of which the thin sheet of drift spread over these hills is largely composed, are perceptibly less smoothly abraded than the coarser materials which have been transported to the lower portions of the valleys, and which were derived from the same sources in the mountains immediately to the west. Wherever these deposits have been removed from the upland tracts, as is often the case over large areas, the disintegration of the subjacent micaceous shales and sandstone has produced a light loamy soil, which supports a fair growth of herbage. In the lower levels, or low benches, the soil is mixed with a large percentage of ferruginous fragments; and in the little intervales along the streams, as well as in the meadows occupying the larger valley-expansions, considerable tracts of exceedingly fertile, dark, finely-comminuted soil frequently occur. These little valleys penetrate far into the base of the neighboring range, where they are unexpectedly encountered, often of limited extent, but always surpassingly beautiful nooks, with clean, verdure-clothed surfaces and pine-fringed slopes.

From the camp near the gorge by which the main branch of the Vermejo enters the Tertiary plateau—a charming spot, nestled between the wooded declivity which forms the eastern rim of the park-basin and the low mesas rising out of the basin, opening out into a little park just to the south, with glimpses of the glistening crests of the Costilla and Vermejo Peaks—the trail strikes across the park in a westerly direction, gaining the crest of the massive hog-back ridge in a distance of some three miles. The eastern declivity is paved with the angular blocks of the reddish-gray quartzitic rock which outcrops in the crest, where it shows a steep inclination to the northwestward, or nearly vertical. This is the great dike-like ridge of the lower sandstone of the Cretaceous, which constitutes so marked and persistent a topographical feature along the eastern foot of the Rocky Mountains for several hundred miles'

Plate 48

Fig. 1

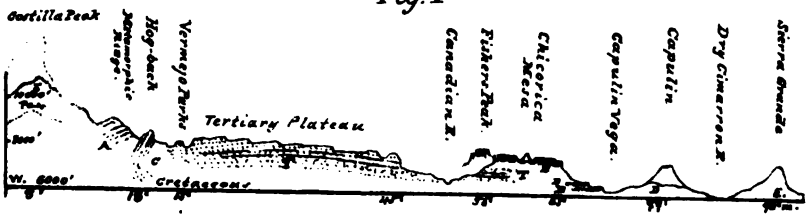


Fig. 2

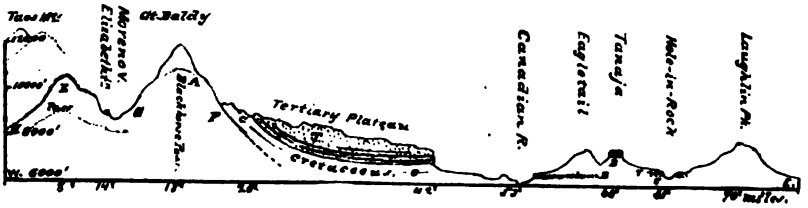
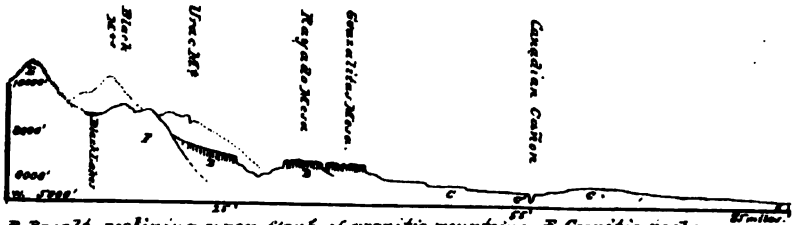


Fig. 3



B. Basalt, reclining upon flank of granitic mountains. F. Granitic rocks. C. Cretaceous occupying plains. C'. Lower Cretaceous sandstone, exposed in Canadian Cañon. E. Waterhead.

extent. But at this point, in its broken-down condition, it has lost somewhat in the distinctive character which lends so picturesque a feature to its outcrop in other localities. Where the Vermejo breaks through the ridge to the south of the trail, in the walls of the picturesque little cañon, the edges of the metamorphosed sandstone are finely displayed, steeply tilted beyond the vertical, with weathered niches and pinnacled crest.

To the west, and parallel with the hog-back, a belt of rolling country two or three miles in width is crossed, in which occasional outcrops of deep-reddish and variegated micaceous sandstone and beds of conglomerate are observed, gently dipping northwestward at an angle much less than the quartzite in the outlying Cretaceous ridge. Here the surface is rough, the soil poor, and covered by bunches of coarse herbage and a straggling growth of gnarled pines and low undergrowth. Finally, the trail enters the gorge of the Vermejo at the foot of the range, and begins the ascent to the summit of the Costilla Pass amidst a wild confusion of rugged igneous masses, rent by a labyrinth of deep, narrow ravines. The walls of the passages are composed of a dark-brown vesicular, lava-like rock, with huge masses of greenstone, piled in irregular rugged ridges or isolated domes. A steep climb of about two miles, and the trail emerges upon the high undulating mountain-meadows, which here occupy the summit of the range, winding through groves of aspen and spruce, and over grassy slopes, in whose bosom dark alpine lakelets mirror the sky. Our approach frightens up a few small teal, who seek refuge in the coarse grasses which grow around the peaty margins. The rude shelters and corral inclosures, half hidden in the neighboring copses, give evidence of occupancy, during the summer months, by flocks which are driven from the valleys to graze the abundant pasturage, and which do much toward lessening the sense of the solitude that reigns around.

The transition from the wild, chaotic belt to these open heights is sudden and unexpected; and thence to the summit the trail pursues a comparatively easy way over a rolling surface, apparently molded in the drift, to the sag or lowest point of the pass, where it attains an altitude of 9,500 feet. To the north and south, the range rises into somewhat higher wooded heights, and to the west the massive snow-clad summits of the Culebras rise out of a mountainous tract just beyond a little valley, which steeply descends to join the Rio Costilla in the basin of the Rio Grande. The snow-fields crowning the Culebras are in places deeply discolored, as though with dust. To the south, the eye wanders over a succession of wooded ridges, which reach down into the Rio Grande basin, finally resting upon the white crowns of the Red River and Taos Mountains, twenty to thirty miles away.

But it is to the eastward we are mainly concerned, and here a revelation meets the gaze. In a broad gap, bounded by long, abrupt, spruce-clad mountain-spurs, whose sides have been devastated by the fires, lies the middle ground, filled by the massive undulations of the metamorphic belt, and just beyond the great Tertiary plateau, whose surface is corrugated by the numerous tributaries of the Canadian flowing to the southeast, the plateau having a very perceptible general descent in the same direction from its culmination in the watershed of the Raton Hills on the north. The intervening ridges often flatten out into level expanses, interspersed with an open growth of pine and extensive upland pastures. In the distance, the view is limited by the Chicorica Mesa, whose level summit, here and there interrupted by conical elevations resembling volcanic cones, stretches from Fisher's Peak far to the

southeastward, where it merges into the haze-obscured, flat-topped buttes and conical peaks in the region east of the Canadian basin. The latter is hidden from view by the high bounding Tertiary plateau, while the great mesa as effectually shuts out the view of the more distant plains. It is a region marked by long lines of parallel ridges, diversified by immense tableland and isolated volcanic cones, to which the mirage lends its illusory repetition of phantom mountains, which one moment are so real as almost to deceive, but the next to melt into strange fantastic shapes, until one can scarce believe they have aught to do with things terrestrial, but rather strange creations of the sky.

From the camp on the Upper Vermejo, a little valley leads by a gradual ascent to the summit of the Francisco Pass over the Raton Hills. In a distance of about four miles, the rise is about 900 feet, the summit of the pass being 8,600 feet in elevation, and situated just within the borders of Colorado. To the west, a rather high, rugged ridge, which is apparently composed of metamorphic rocks, possibly the tilted Cretaceous, continues for some distance along the valley, when it is replaced by the low Tertiary ridges, which latter continue to bound the eastern side of the valley to the summit, often rising 300 to 500 feet above its bed, and in whose sides thin beds of lignite are known to exist.

Looking back over the depression of the park country into which the little valley opens, one of the finest views of Costilla Peak is gained, which, from the north, presents a pyramidal outline, the abrupt northern face bastioned and rent by profound chasms reaching nearly to the summit, which rises between one and two thousand feet above the forest-line. Away to the southward, in a notch to the right of a prominent cone marking an angle in the watershed, or main range, the dome of Great Baldy just rises into view, mantled by a recent fall of snow. To the northwest, and quite near at hand, the diverse and lofty summits of the Vermejo Mountains tower above the nearer hills; and northward, overlooking a succession of low ridges with indications of narrow valleys and park-like openings similar to those south of the pass, the Spanish Peaks appear; the eastern peak peculiar on account of its symmetrical, conical outline, the western and apparently highest mass arching up into a jagged crest, which falls off in an abrupt descent to the west. The lower hills flanking the broad basis from which the Spanish Peaks spring, and which pertain to the Tertiary plateau in its extension north of the Raton Hills, gently slope eastward toward the plains, precisely in the same manner observed in the plateau south of the Ratons. No considerable extent of the latter ridge is commanded from this point, the nearer eminences hiding from view as well the plateau extending southward. To the west, the Tertiary formation apparently abuts upon the metamorphic ridges in the near vicinity, and which it may partially conceal. There is, however, marked dissimilarity in the accompanying topographical features here observed as compared with the great Colorado divide, with which the Raton Hills possess a marked resemblance in many other respects. Here there is no marked valley of erosion intervening between the Tertiary and the granitic mountain-wall, such as exists in the pass at the initial point of the Colorado divide; consequently, in the immediate vicinity of the Francisco Pass, the connection between these later sedimentary deposits and the older metamorphosed formations, as well as their relation to the granitic and igneous nucleus of the main range, is not so clearly manifest. Whether they extend over the Cretaceous hog-back, concealing its tilted ledges from view, or whether this ridge is curved to the westward

close in upon the base of the main range, thus crowding the intervening still older sedimentary formations into a much more contracted belt than that over which they extend along the course of the Vermejo, by steeply tilting or bodily lifting them up on the summit of the axis of elevation, are questions which remain for future explorations to determine. But, as we have already seen to the south, in the Vermejo Park, so to the north, in the Francisco Park, the great dike-ridge of lower Cretaceous sandstone re-appears, where it presents, as shall be shown farther on, a much nearer resemblance to the topographical appearance it exhibits still farther to the north, where it is crowded up and sometimes toppled over, as along the foot of the outlying mountains surrounding Pike's Peak.

From the open glade-like depression, over which lies the Francisco Pass, the trail at once begins the descent through a narrow valley inclosed between steep Tertiary hill-sides, the bed of which, now dry, bears ample evidence of violent floods during the rainy season. Perhaps five miles to the northeast of the summit, the valley suddenly opens out into a charming little park of some three or four hundred acres extent, which is traversed by the Francisco, or an independent affluent of the Purgatory, from the point where it emerges from the hog-back ridge at the head of the park. The valley has an altitude of about 7,800 feet, indicating a descent of 800 feet from the Francisco Pass. Its bed is occupied by a level bench, the stream being bordered by a narrow intervale, from which a range of low sparsely-wooded mesas immediately rises on the north side, extending to the foot of the park, which are apparently composed of Tertiary deposits and overspread with the bowlder and pebble-charged drift. A pretty little open valley separates this low ridge from the high Tertiary table-land immediately on the north, which sweeps down in a long gradual descent from the mountain declivity on the west, and which occupies the upland interval between the park and one of the main branches of the Francisco or Purgatory to the north. In the gap to the west, the Vermejo Mountains burst into view, their nearness permitting a careful study of the topographical features which diversify their eastward aspect; profound gulches, sharp buttress-spurs, steep *débris*-covered inclines springing from the foot of bastioned escarpments and inaccessible walls, over which tower sharp cones, enormous dismantled heights, and massive domes to the height of 5,000 or 6,000 feet above the little valley which nestles at their base; it is one of the most varied and sublime near-mountain scenes in the West.

Beyond the massive metamorphic hills, here and there appear wooded peaks and rounded crests to the south of the Vermejos. The foot of the park is closed in by long grassy slopes, gradually ascending to the steeper declivities of the sandstone hills which descend from the Raton ridge just to the south, and which a mile or so lower down close in upon the stream, confining it to a narrow valley, but only to open out into a similar park-like expansion a few miles lower down, in which is established a little placita, or Mexican hamlet. The stream, a beautiful clear trout-brook, flowing over a bed of gravel and bowlders, and fringed with willow and cottonwood, is turned into an intricacy of channels and pools by the damming at the foot of the valley—the solid structures of the beaver, which abounds in all these mountain-streams. The irrigating acequias, which are taken out along the stream and carried across the high bottom-terrace, reveal in their deep washes the red clayey nature of the superficial deposits which accumulated in these open spaces when they constituted so many little lake-basins, and whose drainage, the result of slow, persistent erosion, by which means the intervening sand-

stone barriers were pierced by narrow gorges, prepared these secluded and often beautiful spots in the midst of a rugged country for occupancy and utilization by man. The origin of these park-expansions along the courses of the streams traversing the Tertiary plateau may be attributable to the erosion of the softer arenaceous deposits, which are known to constitute horizons of considerable vertical extent in this formation.

Crossing the high table-land to the north, which presents an open growth of handsome pines and an extensive pasturage extending eastward in a distance of about three miles, we gain the northern edge of the upland, where it suddenly breaks down into an extensive park-valley, which stretches several miles to the northward, and which is here and there occupied by shallow lakelets. To the left, the park is bounded by a rather abrupt ridge, along the crest of which rises a narrow, much-broken, dike-like escarpment, which is composed of the highly-tilted and metamorphosed Cretaceous sandstone, here nearly set on edge, the dip being to the eastward. To the north, this great dike-wall trends round to the northwestward, where it is lost to view behind the nearer escarpments. The ridge must attain the height of near 500 feet above the valley, of which perhaps 100 feet or more are made up of the nearly vertical escarpment, from the foot of which a steep talus-accumulation, covered by a sparse growth of pines and shrubs, and strewn with great blocks of rock, descends into the valley. On the east, a gradual ascent gains the summits of the bounding Tertiary hills, which, however, to the north become more abrupt, stretching across the farther end of the valley in broken, flat-topped hills, of which there are several (at least four) distinct terrace-levels, all sloping gently eastward. Their slopes facing the valleys are sparsely wooded, and often grassed over to the summit, but in the main they support quite a dense evergreen growth.

Beyond the Tertiary plateau, which crowds into the bay-like recess around the trend of the hog-back ridge, the surface swells up into a high undulating mountain-tract, from the summit of which, nearly twenty miles away in a direction a little east of north, those peerless cones, the Spanish Peaks, seem abruptly to spring. The isolation of these mountain-masses, lying some fifteen miles to the east of the main range, with which they are apparently connected by the elevated mountain-plateau, has much to do with the grandeur of their appearance, and which they always present, viewed from whatever direction. As seen from the plains in the valley of the Purgatoire, sixty miles to the east, they are blended in a single cone resembling, when clothed with snow, a pyramidal mass of cumulus resting upon the horizon. But approached from that direction, their double summits become more and more distinct, often flushed like a purple-tinted cloud; and, from the summit of the Raton Pass, their duality becomes fully established, and as seen from the highlands as far south at least as the Urac ridge, south of the Cimarron.

Regaining the Upper Vermejo, whose diversified park-scenery has lost nothing in interest by the brief sojourn on the other side of the Raton Hills, the trail leads across low hill-flats, through narrow shallow valleys, beside willow-fringed rivulets and ponds, out upon the upland rim of the basin, amidst open pastures dotted with pine, in whose branches families of pretty gray squirrels are busied garnering the season's supplies, and overhead troops of magpies take their vagabondish flight. A shallow depression leads by a gradual descent into the main valley, which we regain at an open space five or six miles below our former camp. Looking back up the valley, isolated flat-topped outliers of Ter-

tiary sandstone rise on the margin of the parks, low terrace-levels extending along the borders of the valley; beyond are seen the metamorphic ridges, and over these to the northwest the cloud-capped southern peaks of the Vermejo Mountains. It only lacks the presence of civilized homes, which no other region more cordially invites and which could in no degree detract from the beauty of its parks or the grandeur of the mountains, to render this one of the most attractive resorts in the country.

The Vermejo, which has here gathered to a fine mountain-brook, soon plunges into the hills, which for six or seven miles closely hem the valley in. The topographical features of nearly all these little valleys along the margin of the parks, where they enter upon that part of their course lying across the Tertiary plateau, are peculiar and quite persistent in their manifestation. The uplands terminate in steep bluff declivities along the stream, 100 to 300 feet or more in height; and wherever they afford vistas of any considerable extent, the rapid descent of the valleys is very appreciable in the lines of successively lower ridges, which close in upon the lower course of the stream. This is markedly exhibited on the Vermejo, as also in the Francisco Valley on the north side of the Raton Hills; and what the view in that direction, looking down the valleys, lacks in mountainous grandeur, is often amply made up in picturesqueness. The steep, wooded heights frequently present a coping of light-red sandstone; sometimes their abrupt declivities are broken by an outlying mass resembling a dismantled fortress or watch-tower guarding the approaches of some little intervale-expansion hidden in the seclusion of the narrow valley, or rounded summits, clothed with open forest-growth and herbage, indicate the presence of a shaly horizon of the formation.

The little stream is clear and cold, its pools furnishing abundant contributions of delicious trout, whose individual variableness is almost as striking as that of some aquarial species; but on our return, three days later, no amount of dexterity and patience, coaxing and piscatorial wickedness, could prevail on the finny gormands to take the fly, so satiated were they of a day's feasting provided by the sudden invasion of locusts that swept down from the north. Where the stream flows through an intervale-bordered expansion, its banks reveal a depth of rich soil, which rests upon the coarse materials of the drift. Frequently, the alluvial or lacustral deposits extend up on the valley-sides on approaching a contraction in the valley, where the stream forces its way through some gorge, which apparently indicates their accumulation when a barrier extended across the foot of the valley, backing its waters into a little lake-basin.

Some seven miles below the point where we regained the Vermejo, the valley widens out into quite an extensive park, in which a number of American families have established comfortable homes, surrounded by pleasant fields, whose fertility is evidenced by stacks of grain and well-filled vegetable-cellars. The park is formed by the union with the main valley of a considerable lateral valley, which rises in the divide south of the headwaters of the Canadian. A low terrace-bench occupies the angle between the two valleys, which is made up of darkish shales, covered by accumulations of drift. The surrounding flat-topped hills are composed of the Tertiary sandstones, which, in the cañon above, dip gently northwest. Here, as also below, in the dark shales in the foot of the hills, a thin layer of lignite occurs. At the lower end of the park, the hills approach the stream, forming a sort of gateway, in the foot of which gray shaly sandstone outcrops, in which were observed the im-

pressions of long linear leaves and endogenous root-like bodies, together with small fucoidal markings. Higher in the bluffs, heavy ledges of buff and reddish sandstone appear, showing a slight inclination down the valley, or southeastward, indicating, in connection with the opposite dip observed at the head of the park, a gentle undulation in the strata, more or less parallel to the metamorphic ridges ten or fifteen miles to the west.

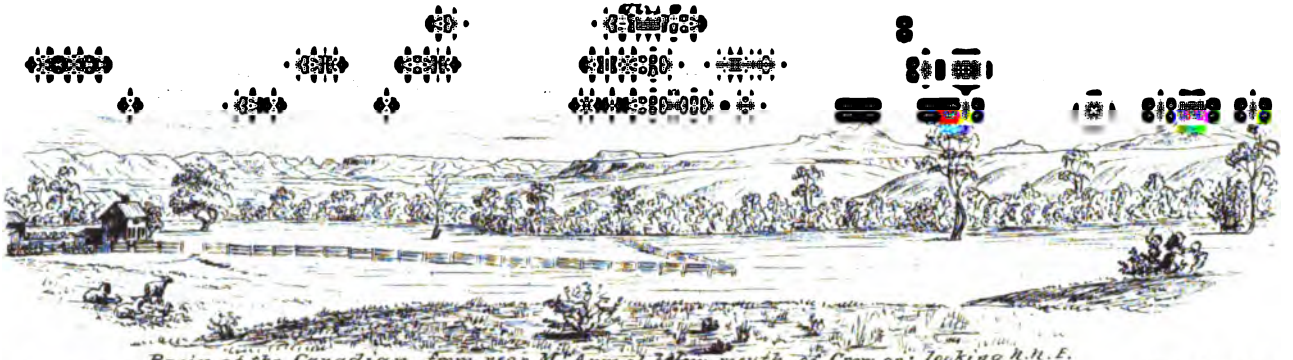
Looking up the valley from this point, we gain a beautiful view of the Vermejos, showing the peaks to the north of the great truncated pyramidal cone, framed in between the walls of the gateway. It is with peculiar emotions each re-appearance of their familiar domes is hailed; and so constantly have they attended our progress through the parks that it is with equal reluctance we now turn our backs in *adios* to these majestic mountains. Thence the valley continues, closely pressed by the hills, a distance of two or three miles, when they suddenly diminish in altitude, and recede as we approach Cameron's, on the Elizabethtown and Trinidad road, where the stream enters a broad depression occupied by low upland undulations, which are clothed with pine and piñon and extensive grazing-range. This undulating belt probably marks the breaking-down or eastern limits of one of the terrace-levels of the Tertiary plateau, or a stage in the drainage of the Post-Tertiary basin, whose waters for a time swept the base of this low escarpment.

Considerable tracts of bottom-land, or low, shelving terrace-benches, continue from this point down the valley some nine miles to Mr. Stout's, the border upland gradually increasing in elevation above the deepening bed of the stream, and drawing nearer on approaching the great bend, where they present bold bluffs and escarpments, often made up of immense beds of sandstone. Here the Vermejo nearly doubles upon itself in the distance of about one and a half miles, and in the course of ages it has excavated its channel deep into the Tertiary deposits, which rise in precipitous and frequently vertical walls to the height of several hundred feet above the shadows that dwell at their base, and which no ray of sunlight penetrates. A practicable bridle-trail traverses the cañon, crossing and recrossing the impetuous stream, whose bed is blocked by immense masses of sandstone dislodged from the ledges above, and paved with bowlders, which afford treacherous footing for our animals, winding beneath overhanging ledges, now crossing a thicket-grown miniature intervale, then rising high up on the shoulder of a steep talus of *débris*—a bit of journey performed with some degree of misgiving, but remembered with liveliest satisfaction. Below the great bend, a distance of four miles, the stream continues walled in its narrow valley by sandstone escarpments, when it sweeps round a low ledge and opens out below into the gradually-widening level intervale, which extends thence some three miles to the embouchure of the valley into the plains.

Rounding the high point in the angle south of the valley, the road passes up through shallow depressions, past deep alcoves studded with picturesque castellated rocks and tottering watch-tower pinnacles, out upon the long piñon covered slope bordering the basin of the Canadian.

The accompanying profiles are intended to exhibit the general structural features in different parts of the region noticed in the foregoing pages, and the relative position of the various geological elements there met with.

Fig. 1, plate 48, represents a profile extending easterly from Costilla Pass in the main range, across the narrow belt of overturned Palæozoic and Mesozoic strata at the base of the mountains, out upon the Tertiary of the Raton plateau, crossing the head of the Canadian basin, the



Basin of the Canadian, from near Mt. Arma, below mouth of Crow cr.; looking N.N.E.

Chicorica Mesa, and terminating in the plains at the foot of Sierra Grande, ninety miles east of the initial point.

A, metamorphosed Mesozoic and Palæozic strata; B, basaltic mesa and benches; C, Cretaceous, Nos. 1–4; D, scoriaceous eruptive rock; E, watershed, or main range; T, Tertiary deposits, with coal.

Fig. 2, plate 48, shows a similar profile from the main range (E) west of the Moreno Valley, across Great Baldy, upon whose eastern flank the Cretaceous and Tertiary (C, T) deposits are upraised high above their outcrop on the borders of the Canadian basin, which latter is bounded on the east by the volcanic hills which rest upon the sedimentary deposits on the borders of the plains, some seventy miles to the east of Taos Pass.

Besides the same elements indicated by corresponding letters in the preceding profile, the following additional ones are here noticed: F, granitic; G, gneiss and quartzite at head of Cimarron Cañon; H, Carboniferous in Taos Cañon.

Fig. 3, plate 48, exhibits a profile still farther to the south of the former, extending above eighty miles to the east of the main watershed into the plains beyond the Canadian, and showing the great basaltic overflow, reclining upon the outlying flanks of the Black Mountain group, and terminating in the mesas of Rayado and Gonzalitas, which were evidently at one time connected with the Tanaja and Chicorica table-lands.

The sections traversed by the above profiles, which are simply an approximation, with no attempt at the representation of details, may be traced by reference to the sketch-map.* Plate 42, fig. 1.

THE CAPULIN.

Late in the autumn of 1874, in company with Messrs. Springer, Morley, Arms, and Porter, a brief visit was made to the Capulin country, which lies to the east of the Canadian, and some sixty miles out from the Spanish Range. The route followed one of the old Santa Fé freight roads, via the Dry Cimarron, crossing the Canadian a short distance below the mouth of Crow Creek. The road rises by a gradual ascent the prairie upland to the south of Tanaja Creek, the higher portions of which command extensive views of the distant mountains—the dome of Great Baldy to the south, the long cumulating crest of the Costilla, and to the north the groups of the Vermejo Mountains, the peculiar topographical features of which are as strikingly exhibited from this great distance as when viewed from the parks at their base—beyond and overtopping the Tertiary plateau, which forms an abrupt wall in the middle distance along the western border of the plain of the Canadian, whose clean carpet of gramma-grass is seldom intruded by the fields of *Artemisia* so characteristic of the plains in other quarters.

Pursuing an east-northeast course, in a distance of about fifteen miles, the road regains the valley of Tanaja Creek, passing on the way the Tanaja and Eagletail Buttes, two considerable outlying basaltic elevations lying between the former stream and the Canadian, along which their broad-spreading basis forms a low range of basaltic bluffs. The valley is here a shallow depression, inclosed by low bluffs resting upon shales, and terminating above in a considerable deposit of yellow-

* It is proper, and besides a positive pleasure, to state my indebtedness to Messrs. G. A. Bushnell and Harry Whigham, as also to Mr. Lewis Kingman, and my friend Mr. Morley, for the data embodied in the sketch-map, by which I have no desire to make these gentlemen responsible for the inaccuracies, but whatever is good I gladly acknowledge is their own contribution.

ish sandstone, which often forms picturesque castellated masses, in which the elements have wrought miniature caverns, and which are covered with cedar, piñon, and low pines. The shales are undoubtedly of Cretaceous age, and it would appear equally probable that the overlying sandstone prove to be the base of the Tertiary formation. A few miles farther on, and perhaps twenty miles from the crossing of the Canadian, Hole-in-Rock is reached, a little pool at the foot of a low ledge of very tough, grayish, phonolitic rock, which seems to be a dike pushed up through the sedimentary strata, along an east-west line, and which here crosses the head of a little branch of the Tanaja.

From this point, the road passes over a sort of low divide, and yet within the depression, which is here bordered by similar topographic and stratigraphic features observed on the upper course of Tanaja Creek. In the course of a few miles, a more open country is reached; to the left or northwest, lowish basaltic-capped mesas, in which a branch of the Una de Gato rises, and in the opposite direction the huge eruptive pile culminating in Laughlin's Peak. The latter mountain rises from a broad, undulating, grassy swell in the plain, and in which Mr. Kingman reports the occurrence of sandstone similar to that appearing in the bluffs bordering the old valley-depression, which lies to the northwest. A gentle descent amidst surroundings which every step become more emphatically marked by the evidences of igneous phenomena which here abound, and in a distance of fifteen miles from Hole-in-Rock, we gain the Capulin Vega, and camp beside a little pool which oozes from the swelling, peaty soil in the midst of the plain.

The Capulin Vega is quite an extensive shallow basin, surrounded by gentle acclivities, low basaltic terraces, and isolated mountains whose summits rise above the plain 1,500 to 1,800 feet, or about 8,000 feet above the sea. Its surface is quite level, with here and there shallow ponds; the mud of their sloping shores whitened by an efflorescence which renders the water brackish at this season, and their margins unrelieved by a solitary tree. In the low places flooded by the rains, considerable tracts of coarse herbage, suitable for hay, occur; the drier portions of the vega possess a loamy soil, which is largely made up of the sand derived from the degradation of the surrounding igneous rocks. To the southwest, the surface gradually ascends into the upland at the base of Laughlin's Peak; and, on the northwest, the basin is hemmed in by low basaltic escarpments. To the east, the prairie rises into what appear to be broken-down volcanic cones, and beyond lies the broad-spreading mass of the Sierra Grande, to the right of which, and much nearer, a nearly perfect crater-cone appears—the latter some eight miles and the former fifteen miles distant—which are destitute of trees, and grassed over to their summits with a tough reddish wire-grass, which gives a delicate pleasing tint to their smooth sides. But the most interesting feature of the environments is the Capulin Mountain, a perfectly symmetrical cone, rising from a broad low basis of scoriaceous rock to the height of near 1,800 feet above the vega. The summit is truncated, and occupied by a funnel-shaped crater between 200 and 300 feet in depth, and which is said to be grassed over to its bottom; on the southwest, the rim is slightly broken down, revealing the character of the crater to best advantage. The outer wall on the east side, as seen from the vega, presents an abrupt escarpment perhaps 50 feet in height; otherwise, the slope is very uniform, and covered with herbage and a growth of shrubs or dwarf-pines. The appearance of the mountain as seen from the vega, to the southwest, is shown in the middle section of the foregoing sketch. The eruptive material occurring at the

base of the cone is coarsely vesicular and of a dark-brownish color, entirely dissimilar in appearance from the basalt in the neighboring mesas, which latter varies from reddish to dark brown, specked with light gray, and homogeneous in texture. To the eastward, the low, uneven platform drops down into the depression between the Capulin and Sierra Grande, in which is gathered the drainage of the headwaters of the dry Cimarron.

The lines of low basalt-capped bluffs on the west and northwest borders of the vega present at least two distinct benches, of which the lowest is about 75 feet in height, the other or highest (that shown on the left of the Capulin in the sketch) perhaps as high again above the vega. The lower one presents along its crest frequent abrupt outcrops, but in the higher bench the basalt forms a low uninterrupted wall, showing very irregular columnar structure, below which the *débris*-strewn talus descends to the lower levels. There is also here observed a lower basaltic outcrop, which forms a third irregular bench, somewhat less than half the height of the next higher bench; but whether it represents a distinct deposit, independent of those appearing in the higher terraces, was not determined. Indeed, the thickness of the basaltic beds was in no place satisfactorily exhibited, though in places the upper one shows a solid outcrop of 20 to 30 feet without revealing the nature of the deposits upon which it rests.

Nearly due north of the Vega Spring, overlooking the intervening basaltic beds above alluded to, another volcanic cone rises to view, which, though not so perfect as the Capulin, is yet unmistakable in its origin; the western rim is deeply broken down, showing the crater-depression, while the opposite wall still remains perfect, and is much like that of the Capulin. Perhaps not quite as high as the latter cone, it rests upon a similar uneven upland eminence, and is grassed over to the summit. The formation of these high spreading bases seems to be directly attributable to the volcanoes themselves, and may have been built up in the early stages of the eruption, which terminated in the building-up of the conical elevations around their orifices.

The Sierra Grande, like Laughlin's Peak, when seen from the west, presents a broad-based mass gradually culminating in a blunt or rounded summit, which attains an altitude of about 8,000 feet. Laughlin's Peak, however, viewed from the northwestward, shows a deep depression extending half-way from the summit to its broad base, and which has all the appearances of a crater, the northwestern rim of which has been demolished. The contour of both these mountains, as also that of the Eagletail, suggests their possible origin as centers of volcanic eruption; but they probably mark the sites of much larger and possibly older craters than the Capulin and others, which still retain their symmetrical form and undoubted character. Their conical shape would seem to indicate a different origin from that of the basaltic overflows, which distinction, in the case of the Capulin, is also quite manifest in the difference in the physical character of the igneous products ejected, and out of which the cone surrounding its crater was built up.

There would appear to be several distinct basaltic deposits in this region, as evidenced by the presence of at least three or four benches, or terraces, of different levels. As stated above, there are at least two such deposits, occupying comparatively low elevations, bordering the Capulin Vega; and probably a third and lowest bench, which latter, from the character of the material thrown out from the excavations of some burrowing animal (perhaps the prairie-dog) in the edge of the vega, apparently rests upon light, indurated, marly shales, probably

referable to the Cretaceous. These benches occupy too considerable areas, and are too uniform in their relations to one another (although slightly undulating, as though deposited upon an uneven surface), to admit of their present position being referred to the subsidence or settling of portions of the same basaltic level. Yet they may have originated in one and the same outpouring of molten matter, which was deposited upon or spread over the inequalities of the surface, preserving, as it were, the topographical features wrought at the close of the Tertiary, and immediately preceding the epoch during which the present contours were fashioned, and which latter involved alike the wasting of the basaltic overflows and the old terrace-levels in the Tertiary and Cretaceous, which were flooded by the igneous matter.

Besides these less conspicuous deposits, there is the great basaltic bed capping the Chicorica Mesa, in the midst of which there occur what appear to be distinct volcanic cones and craters of later origin. The Tanaja is probably an isolated remnant of the same great overflow, which involved an immense extent of territory along the eastern flank of the Spanish range, the actual extent of which may be inferred from the wide distribution of the comparatively insignificant areas which still exist in the mesas of Rayado and Gonzalitas, between the Cimarron and Ocaté, and probably other similar outliers farther to the southward. As has been suggested by Dr. Hayden, the origin of these immense outpourings of igneous products is probably due to immense and innumerable fissures in the earth's crust, the direction of which seems to have been determined by forces acting nearly at right angles to the old axis of upheaval in the range to the west. Through these fissures the molten matter escaped, overflowing extensive areas of the Tertiary plateau and perhaps lower levels of the Cretaceous, as would appear from the evidence afforded by the several distinct benches seen to-day in which these basaltic deposits vary in relative level at least 1,500 feet, comparing the extremes, as represented by the lowest bench on the borders of the Capulin Vega and the great bed forming the summit of the Chicorica Mesa, a few miles to the northwest. This great outburst of basaltic-making materials probably antedates the formation of the volcanic cones, which latter, it would appear, more properly pertain to a later time, or during the subsidence of the active period of overflow, representing, as it were, the expiring throes of volcanic action, where the forces were concentrated, and only manifesting their existence in isolated centers of true volcanic crater-building phenomena.

When we come to review the few facts elicited during a flying visit, they seem merely to approach the threshold of a field the investigation of which would clear away all uncertainty respecting the origin and relations existing between the various and diverse phenomena there manifested.

GEOGRAPHICAL VARIATION AMONG NORTH AMERICAN MAMMALS, ESPECIALLY IN RESPECT TO SIZE.

By J. A. Allen.

FERÆ (Suborder FISSIPEDIA).

Having recently had an opportunity (through the kindness of Professor Baird) of studying with some care the magnificent series of skulls of the North American *Mammalia* belonging to the National Museum (amounting often to eighty or a hundred specimens of a single species), I have been strongly impressed with the different degrees of variability exhibited by the representatives of the species and genera of even the same family. The variation in size, for instance, with latitude, in the Wolves and Foxes is surprisingly great, amounting in some species (as will be shown later) to 25 per cent. of the average size of the species, while in other species of the *Feræ* it is almost *nil*. Contrary to the general supposition, the variation in size among representatives of the same species is not always a decrease with the decrease of the latitude of the locality, but is in some cases exactly the reverse, in some species there being a very considerable and indisputable *increase southward*. This, for instance, is very markedly true of some species of *Felis* and in *Procyon lotor*. Consequently, the very generally-received impression that in North America the species of *Mammalia* diminish in size southward, or with the decrease in the latitude (and altitude) of the locality, requires modification. While such is generally the case, the reverse of this too often occurs, with occasional instances also of a total absence of variation in size with locality, to be considered as forming "the exceptions" necessary to "prove the rule".

That there are such exceptions, both among Birds and Mammals, I have been long aware, and long since noticed that where there is an actual increase in size to the southward it occurs in species that belong to families or genera that are mainly developed within the tropics, there reaching their maximum development, both in respect to the number of their specific representatives, and in respect to the size to which some of the species attain. This fact seems also to have been observed by others.*

Most of the Mammals of North America belong to families, subfamilies, or genera which have their greatest development in the temperate or colder portions of the northern hemisphere, as the *Cervidæ*, the *Canidæ*, the *Mustelidæ*, the *Sciuridæ* (especially the subfamily *Arctomy-*

* I find that Mr. Robert Ridgway, some two years since, thus referred to this point. In alluding to the smaller size of Mexican specimens of *Catharpes mexicanus* as compared with specimens from Colorado, (*C. mexicanus* var. *conspusus*) he says: "As we find this peculiarity exactly paralleled in the *Thryotharus* [*ludovicianus* of the Atlantic States, may not these facts point out a law to the effect that in genera and species in the temperate zone the *increase in size with latitude is toward the region of the highest development of the group?*"—Baird, Brewer, and Ridgway's Birds of North America, Vol. III, App., p. 503, 1874.

inæ), the *Leporidæ*, the *Castoridæ*, the *Arvicolinæ* among the *Muridæ*, the *Saccomyidæ*, *Geomyidæ*, etc. These rarely present an exception to the general law of decrease in size southward, though the variation is less (in fact, occasionally almost *nil*) in some species than in the others. The more marked exceptions, or those in which there is an actual increase in size southward, occur in those families that reach their highest development with the tropics, as the *Felidæ* and *Procyonidæ*.

In some species (as I have elsewhere noticed), there probably exists a double decadence in size, the individual reaching its maximum dimensions where the conditions of environment are most favorable for the existence of the species, diminishing in size toward the northern (through scarcity of food and severity of climate) as well as toward the southern (in consequence of the enervating influence of tropical or semi-tropical conditions) limit of its distribution.

In a general way, the correlation of size with geographical distribution may be formulated in the following propositions:

(1) *The maximum physical development of the individual is attained where the conditions of environment are most favorable to the life of the species.* Species being primarily limited in their distribution by climatic conditions, their representatives living at or near either of ther respective latitudinal boundaries are more or less unfavorably affected by the influences that finally limit the range of the species. These influences may be the direct effects of too high or too low a temperature, too little or too much humidity, or their indirect effects acting upon the plants or other sources of food. Hence the size of the individual generally correlates with the abundance or scarcity of food. Different species being constitutionally fitted for different climatic conditions, surroundings favorable to one may be very unfavorable to others, even of the same family or genus. Hence

(2) *The largest species of a group* (genus, subfamily, or family, as the case may be) *are found where the group to which they severally belong reaches its highest development, or where it has what may be termed its center of distribution.* In other words, species of a given group attain their maximum size where the conditions of existence for the group in question are the most favorable, just as the largest representatives of a species are found where the conditions are most favorable for the existence of the species.

(3) *The most "typical" or most generalized representatives of a group are found also near its center of distribution, outlying forms being generally more or less "aberrant" or specialized.* Thus the *Cervidæ*, though nearly cosmopolitan in their distribution, attain their greatest development, both as respects the *size* and the *number* of the species, in the temperate portions of the northern hemisphere. The tropical species of this group are the smallest of its representatives. Those of the temperate and cold-temperate regions are the largest, where, too, the species are the most numerous. Most of the species of this family also have a wide geographical range, and their representatives respectively present great differences in size with locality, namely, a very marked decrease in size to the southward. The possession of large, branching, deciduous antlers forms one of the marked features of the family. These appendages attain their greatest development in the northern species, the tropical forms having them reduced almost to mere spikes, which in some species never pass beyond a rudimentary state. Beginning at the northward, we have first, in the subarctic and cold-temperate regions, the Alcine and Sangerine forms, species of the largest size, with heavy, large antlers. Next, in the colder-temperate regions, come the Elaphine species, also of very large size, with nearly the largest antlers of any of the *Cervidæ*. We

next meet, in the temperate and warmer regions generally, the smaller Capreoline and Rusine forms, decreasing in size southward, with a rapid reduction also in the size of the antlers. Finally, in the subtropical and tropical portions of the Old World, we meet with antlerless forms, that constitute the smallest species known among the *Cervidæ* and their allies.

The decrease in the size of the antlers southward among the different genera and species is also well marked among individuals of the same species, especially among the Cariacine deer of North America.

The *Canidæ* form another family, which, while having a nearly cosmopolitan distribution, is most numerously represented in the temperate regions of the northern hemisphere, where also occur nearly all of the larger species, and where are exclusively found the true Wolves and Foxes. In respect to the latter, the larger species of each occur only at the northward, and the smaller at the southward. Thus, in North America, the large Gray Wolf ranges from the arctic regions to Florida and Mexico, while the Coyote is not found much to the northward of the great campestrian region of the interior. The Common Fox ranges also from the subarctic districts southward to the Gulf of Mexico, while the smaller Gray Fox finds its northern limit near the parallel of 42°, while a third still smaller species is confined within the warmer-temperate latitudes. At the extreme northward, we find, however, a smaller arctic form, on the extreme northern confines of the habitat of the family. In the Wolves and Foxes, decrease in size to the southward is strongly marked, being probably not exceeded in any other group, though perhaps nearly equaled in some of the Cariacine Deer.

The *Ursidæ*, while having a wide geographical range, are confined mainly to the north hemisphere, throughout which they have representatives. Here again the larger species are northern, while all the warm-temperate and subtropical forms are small. There is also a corresponding decrease in size southward among the representatives of the several species. (See later portions of the paper for a somewhat detailed discussion of the North American species.)

The *Mustelidæ*, while mainly confined to the northern hemisphere, have also representatives south of the equator. Of the *Mustelinæ* proper, all the larger species are boreal, though some of the smaller extend also to the arctic regions. The Wolverine, the largest of the group, is the most boreal; the Fisher and the Marten, the next in size, are mainly confined to the subarctic and cold-temperate regions; the Mink, next in size, extends farther southward; the Weasels range also into the middle-temperate latitudes, with a single species occurring (only at considerable altitudes) under the tropics. *Galictis* is its single tropical representative, and is also the most specialized (though not the smallest) type of the group. The *Melinæ* and *Enhydrinæ*, each with a single American representative, and both boreal, are also among the largest representatives of the family. The *Mephitinæ*, of medium or rather small size, are strictly a warm-temperate and tropical group, with representatives extending from the northern parts of the United States southward to the southern parts of South America. The *Lutrinæ* have a wider range, being found throughout the tropics as well as in the temperate and colder regions, and apparently present not a very great range of geographical variation.

The *Felidæ*, while possessing an almost cosmopolitan range, have their greatest development within the tropics, where they attain their maximum size and number of species. The single boreal genus found in America is one of the most specialized forms of the family. As will be shown later, the American representatives of this family present a notable exception to the general law of decrease in size toward the

south, and confirm the law of increase in size toward the geographical center of the group to which they belong.

The *Procyonidæ* are essentially a tropical family, in which regions are found the largest species and the greatest variety of forms. The single North American species presents a marked *increase in size southward*, as will be fully shown later.

The *Glires*, or *Rodentia*, are found throughout the greater part of the world, but are represented by special groups in different regions. Being strictly herbivorous, they are most numerously developed in the temperate and warmer latitudes. The largest known species are tropical, but others of large size are more or less boreal. In the northern hemisphere, the largest species is the Beaver, which formerly ranged throughout the temperate latitudes. Of the *Muridæ*, the larger species are southern, the smaller northern; and there is a tendency (among some of the species, at least) to an increase in size southward, as in some of the varieties of *Hesperomys leucopus*. The *Arvicolinæ*, on the other hand, are subarctic and temperate in their distribution, and markedly increase in size to the northward. Here, likewise, the largest species of the group are met with.

The *Sciuridæ* are also a nearly cosmopolitan group, with different genera and subfamilies specially characteristic of different regions. The *Sciurinæ* are most numerously represented in the warm-temperate and subtropical latitudes, where also occur the largest species. Yet some of those of the more northern districts show a decided tendency to diminution in size southward, while in others the decrease in this direction is less marked. The *Arctomyinæ* are temperate and subarctic, and the largest species occur at the northward. Parry's Marmot is the most boreal and much the largest. Franklin's Spermophile next succeeds, and is one of the largest of the group. *Spermophilus grammurus* (with its varieties *Beecheyi* and *Douglassi*), of about the same dimension, occupies the elevated interior and the Pacific slope, extending, however, quite far southward. The smallest of the group, *S. Harrisii*, *S. spilosoma*, and *S. mexicana*, have a more southern range. In all of these species, there is a marked decrease in size to the southward in their respective representatives, as there is among the species themselves. *Arctomys* and *Sciuropterus* are boreal genera, with their larger species and varieties occurring at the northward, and a northward increase in size in the representatives of their several forms.

The *Leporidæ* of America are mainly restricted to the northern continent, their center of development as respects the number of species, being the United States. Here occur also nearly all of the larger forms. The Polar Hare, one of the largest, is strictly arctic; three or four others of nearly equal size find their northern limit, with one exception, south of the forty-ninth parallel. The most remarkable trait of the family is the rather small degree of geographical variation its representatives present, both as respects size and coloration. The difference in size between the largest and smallest species is less than is often found in any co-ordinate group having the same number of species, and the species themselves present great constancy of character. There is generally a slight decrease in size southward among individuals of the same species, but sometimes the difference is scarcely perceptible. In the most northerly but one* of the species (*Lepus americanus*), there is apparently a very slight decrease (certainly no increase) in size northward.

* The material at hand is too scanty to afford grounds for any satisfactory generalization respecting the Polar Hare.

With these general remarks, we will pass now to a more special examination of geographical variation in size in several of the more common species of the North American *Feræ*, based on the abundant material in the National Museum.

CANIS LUPUS.

The common Gray Wolf of the northern hemisphere presents a range of individual variation in color exceeded by but few known species of Mammals; gray, white, and black individuals, with various intermediate stages of coloration, occurring with greater or less frequency wherever the species abounds, several of these varieties sometimes occurring in the same litter. Black and white wolves seem to occur more frequently at some localities than others, but gray is generally nearly everywhere the prevailing color. Cream-colored and rufous varieties are also said to have a wide prevalence over some parts of the great plains of the interior. To what extent these variations in color are to be considered as geographic is not yet well established.* With such an evident tendency to variability, it is not surprising that geographical variation in size is displayed in this species to a marked degree. The variation in this respect constitutes a pretty uniform decrease in size southward, as shown (see the subjoined table) by the size of the skull, only fully adult skulls being here taken. The largest are from Fort Simpson and other localities in or near the Mackenzie River district, six of which, out of a series of nine specimens, exceed 10.25 inches in length (one reaching 11.50!), and the other three average above 9.50, the whole averaging 10.38. The next in size are from the region about Puget Sound, a series of three (the only ones in the collection), averaging nearly 10.50. Of sixteen specimens from Forts Benton, Union, and Randall, on the Upper Missouri, the average is 9.45, the extremes being 10.50 and 8.50. Nine specimens from Forts Kearney and Harker (chiefly from Fort Kearney, and all pretty old) average a little larger than the Upper Missouri specimens, the extremes being 10.15 and 9.35. A single specimen from the mountains of New Mexico reaches 10.00, while the three most southern (from the Rio Grande and Sonora, Mexico) average only 8.37, being the smallest of the whole series, and averaging 2.00 shorter than the series of nine from the Mackenzie River region. This difference is fully 25 per cent. of the average size of a series of upward of eighty specimens; while the difference between the smallest (from Saltillo, Mexico) and the largest (from Fort Simpson) is 3.75, or nearly 40 per cent. of the average size of the whole series!

* See further on color variation in this species, Bull. Mus. Comp. Zoöl., vol. i, pp. 154-158.

Measurements of forty-five North American skulls of CANUS LUPUS.*

Catalogue number.	Original number.	Locality.	Sex.	Total length.	Greatest width.	Distance between orbits.	Nasal bones, length.	Upper incisors from front to hinder margin of palate.	Upper incisors, width between external edges.	Lower jaw, length.	Lower jaw, height.	Remarks.
9001	.....	Fort Simpson, Hudson's Bay Territory	.....	11.50	6.20	2.08	4.45	5.50	2.10	8.00	3.34	
9003	.....	.....do	.....	10.75	5.85	2.07	3.94	5.00	2.05	7.75	3.25	
9000	.....	.....do	.....	10.60	5.65	1.85	4.20	4.95	1.95	7.40	3.00	
9002	.....	.....do	.....	10.35	.....	1.87	4.12	.....	.....	.....	.....	"White." Skull imperfect.
6217	1054	100 miles northwest of Fort Yukon	♂	10.35	5.50	1.90	3.87	5.00	1.95	7.60	3.10	
7154	2	Fort Yukon	♀	10.25	5.26	1.80	4.00	5.05	1.85	7.65	3.00	"Black."
6218	.....	Peel's River	.....	9.50	5.35	1.70	3.65	4.65	1.73	7.00	2.75	
6256	.....	Fort Rae	.....	9.20	4.50	1.45	3.57	4.60	1.65	6.85	2.50	
6257	.....	.....do	.....	9.80	4.90	1.67	3.50	4.50	1.75	7.00	2.82	
1194	.....	Minnesota	.....	9.95	5.15	1.65	3.87	4.90	1.85	7.45	2.80	Very aged.
1804	.....	Adirondack Mountains, New York	.....	9.20	4.95	1.73	3.50	4.35	1.55	6.85	2.70	Rather young.
3438	.....	Puget Sound	.....	10.55	5.67	2.07	4.07	5.12	1.90	.....	.....	
4114	.....	Oregon	.....	9.50	5.00	1.80	3.42	4.65	1.75	7.10	2.86	Marked "*L. gigas*".
	.....	.....do	.....	10.70	5.90	.....	.....	.....	.....	.....	.....	"*Lupus gigas* Townsend." Measurements from Baird.
13949	.....	Little Chief Mountain, forty-ninth parallel	.....	9.15	5.00	1.75	3.55	4.60	1.75	6.80	2.65	
13965	.....	Fort Benton	.....	9.80	5.35	1.80	3.70	4.75	1.83	7.20	2.92	
13966	.....	.....do	.....	9.40	5.20	2.15	3.50	4.45	1.95	7.00	2.92	
13967	.....	.....do	.....	9.60	5.35	1.77	3.50	4.70	1.70	7.00	3.00	
2972	.....	Fort Union	.....	10.50	.....	1.80	3.88	4.85	2.05	7.20	2.90	
3037	.....	.....do	.....	9.90	5.15	1.84	3.70	4.75	1.78	6.92	2.85	
3031	.....	.....do	.....	9.50	5.00	1.85	3.33	4.70	2.00	6.85	2.70	
4124	.....	.....do	.....	8.85	4.75	1.50	3.40	4.35	1.55	6.30	2.50	
3020	.....	.....do	.....	9.15	.....	1.53	3.35	4.60	1.62	6.80	2.68	
3005	.....	.....do	.....	8.50	4.50	1.30	3.12	4.27	1.45	6.00	2.33	
2954	.....	.....do	.....	9.70	5.50	2.05	3.70	4.85	1.88	7.10	2.85	A short, very broad skull.
2984	.....	.....do	.....	9.40	5.25	1.98	3.20	4.48	1.85	.....	.....	Six others in the same lot of similar dimensions.
2994	.....	.....do	.....	9.50	.....	1.92	3.45	4.75	1.87	6.75	2.75	Very old.
12906	.....	Fort Randall, Dak	.....	9.00	4.85	1.70	3.20	4.37	1.75	6.65	2.58	
12907	.....	.....do	.....	9.42	4.75	1.50	3.53	4.53	1.68	6.80	2.75	
12302	.....	.....do	.....	9.75	5.25	1.72	3.62	4.57	1.78	7.00	2.95	
2611	.....	Fort Kearney, Nebr	.....	9.35	5.00	1.50	3.50	4.57	1.62	6.70	2.62	
[illegible]	.....	.....do	.....	10.15	5.40	1.85	3.80	4.98	1.87	7.35	3.20	
1314	.....	.....do	.....	9.65	5.35	1.83	3.50	4.75	2.00	6.90	2.85	
3591	.....	.....do	.....	9.65	4.87	1.68	3.75	4.80	1.80	7.05	2.90	
[illegible]	.....	.....do	.....	9.80	5.25	1.83	3.65	4.60	1.90	.....	.....	

3686	.....	.....do	.....	10.00	5.50	1.87	3.80	4.80	1.97	7.18	3.00		
1312	.....	.....do	♂	9.75	5.25	1.78	3.67	5.00	1.80	7.38	3.15	"Gray."	
11592	.....	Fort Harker, Kans.	.....	9.50	5.06	1.72	3.50	4.65	1.80	.....	.....		
11591	.....	.....do	.....	10.15	4.85	1.62	3.80	5.00	1.85	7.20	3.00		
3341	.....	New Mexico	.....	10.00	4.92	1.65	3.65	4.90	1.75	7.35	2.93		
8098	.....	Fort Cobb, Ind. Ter	.....	9.25	4.85	1.72	3.50	4.50	1.65	6.60	2.65		
1380	.....	Matamoras, Mexico	.....	8.75	4.62	1.65	3.18	4.25	1.53	6.35	2.63		
2193	.....	Santa Cruz (Sonora), Mexico	.....	8.60	4.55	1.55	3.07	4.20	1.57	6.30	2.63		
1379	.....	Saltillo, Mexico	.....	7.75	4.05	.....	.....	.....	.....	.....	.....	Measurements from Baird.	

* The measurements in this and the following tables are all taken either with calipers or dividers, and are expressed in hundredths of the English inch. They hence always indicate the length in a straight line between the points indicated.

CANIS LATRANS.

The Coyote, or Prairie Wolf, the nearest American affine of the Gray Wolf, is as remarkable for its constancy of character, especially in respect to color, as the latter is for its variability. The individual variations in the color of *Canis latrans* consist generally in the depth or intensity of the shadings of black or rufous that more or less pervade the pelage of certain parts of the head and body. Although considerable variations have been noticed in respect to the form of the skull, they are small in proportion to those presented by *Canis lupus*. It is also much less influenced apparently by locality. The species has, however, a less extended range than *Canis lupus*, and the specimens at command represent localities less widely separated than do the series of skulls of *Canis lupus*.

Measurements of forty skulls are given below, mainly from Nebraska, Dakota, and Wyoming. The most distant localities are Columbia River and Fort Tejon, California, Southern Texas, and Fort Union, Montana. Of this series of forty skulls, the average is 7.40; only two attain a length of 8.00, one of which (measuring 8.00 in length) is from Fort Union, and the other (8.05 inches in length) is from Fort Massachusetts, New Mexico. Only two fall below 6.95, one of which measures 6.65 and the other 6.50; the smaller being from the Coppermine River, New Mexico, and the other from Fort Randall, Dakota. Of thirteen specimens from Fort Randall, the largest measures 7.60 in length and the smallest 6.65, the majority (more than three-fourths) falling between 7.00 and 7.50, thus presenting a remarkable uniformity in size. Ten others from Fort Kearney average fully as large, the extremes being 6.95 and 7.60, while four-fifths of them fall between 7.00 and 7.50. Three specimens from Fort Tejon, California, measure respectively 7.95, 7.60, and 7.45, or above the average of those from Dakota and Nebraska! Four specimens from Wyoming Territory, however, measure each 7.80. A single San Diego specimen measures 7.75, and two specimens from Southern Texas respectively 6.95 and 7.00, or but little below the average of northern specimens. Of four specimens from New Mexico, three attain or exceed 7.40, one reaching 8.05 and forming the largest of the series; the other, with a length of only 6.50, forms the smallest of the series, both the largest and the smallest being from New Mexico. It thus appears that in *Canis latrans* there is comparatively little decrease in size southward, instead of the southern averaging fully 25 per cent. smaller, as is the case in *Canis lupus*. The difference between the extremes is only 1.55, or about 20 per cent., against twice that amount in *Canis lupus*. Throwing out the two skulls that fall below 6.95 would reduce the difference between the extremes to 1.10, and the variation to only 15 per cent. of the average! In both *Canis latrans* and *Canis lupus*, the width of the skull averages about one-half the length, ranging in *Canis latrans* from 0.49 to 0.52, while in *Canis lupus* the range in this proportion is from 0.48 to 0.56.

A glance at the table shows that while the Upper Missouri specimens are rather younger than those from Fort Kearney, they rather exceed them in size, and the difference would be somewhat greater if they were of strictly corresponding ages. The single very large skull from New Mexico is also that of a very old individual.

Measurements of forty skulls of CANIS LATRANS.

Catalogue number.	Locality.	Sex.	Total length.	Greatest width.	Distance between orbits.	Nasal bones, length.	Upper incisors from front to hinder margin of palate.	Upper incisors, width between external edges.	Lower jaw, length.	Lower jaw, height.	Remarks.
3025	Fort Union		8.00	3.95	1.30	2.82	4.10	1.48			
12902	Fort Randall, Dak	♂	7.40	3.43	1.13	2.80	3.60	1.15	5.25	1.95	Rather young.
12893	do	♂	7.50	3.65	1.18	2.82	3.67	1.15	5.50	2.06	Do.
12905	do	♂	7.50	3.77	1.18	2.80	3.67	1.20	5.50	2.16	Do.
12899	do	♂	7.60	3.80	1.25	2.87	3.75	1.20	5.53	2.25	Do.
12897	do	♂	7.40	3.80	1.15	2.80	3.60	1.19	5.30	2.00	Do.
12896	do		7.25	3.70	1.15	2.75	3.60	1.19	5.32	1.95	Do.
12898	do		7.15	3.52	1.20	2.70	3.53	1.10	5.27	1.85	Do.
12903	do		7.10	3.45	1.18	2.88	3.50	1.15	5.05	1.85	Quite young.
12904	do	♀	7.00	3.56	1.15	2.50	3.53	1.09	5.12	1.95	
12892	do	♀	6.95	3.52	1.14	2.40	3.27	1.12	5.02	2.10	
12901	do	♀	6.65	3.38	1.12	2.37	3.38	1.04	4.95	1.85	
12887	do	♀	7.25	3.70	1.16	2.70	3.58	1.12	5.25	2.08	Aged.
1327	Fort Kearney, Nebr	♀	7.00	3.65	1.26	2.65	3.38	1.15	5.10	1.90	"Eight to ten years old."
1335	do	♀	6.95	3.75	1.25	2.60	3.45	1.15	5.15	2.06	"Ten or eleven years old."
1336	do	♀	7.40	3.80	1.25	2.90	3.93	1.13	5.27	2.00	"Four years old."
1338	do	♀	7.12	3.62	1.20	2.62	3.63	1.20	5.15	1.88	"Two to four years old."
1322	do	♀	7.35	3.62	1.23	2.75	3.63	1.13	5.30	1.90	"Eight years old."
1332	do	♀	7.10	3.62	1.20	2.58	3.74	1.18	5.37	2.00	"One to two years old."
1328	do	♀	7.50	3.62	1.05	2.95	3.65	1.18	5.40	2.18	"One and a half to three years old."
1341	do	♂	7.60	3.62	1.30	2.70	3.75	1.18	5.38	2.00	
1323	do	♂	7.25	3.50	1.20	2.70	3.57	1.12	5.15	1.97	"Eight to twelve years old."
1339	do	♂	7.30	3.68	1.20	2.88	3.65	1.15	5.40	2.00	
11552	Wyoming Territory		7.80								
11554	do		7.80	3.95							
11559	do		7.80	3.82							
11558	do		7.80	3.95							
1916	Columbia River		7.60	3.78							
4113	Oregon		7.25	3.75							
3323	Nebraska	♂	7.80	3.80							
3332	Fort Massachusetts, N. Mex		8.05	3.94							
1000	Coppermine River, N. Mex		7.40								Very aged.
1001	do		6.50	3.28							
1019	Texas	♂	6.95	3.53							Rather aged.
975	Frontera, Tex		7.00	3.62							Very aged.
2198	San Francisco Mountains, N. Mex		7.60	3.62							Do.
1218	San Diego, Cal		7.75	3.77							Do.
3577	Fort Tejon, Cal		7.95	4.00							Do.
3616	do		7.60	3.65							Adult.
3617	do		7.45	3.48							Rather young.

VULPES ALOPEX ET VARS.

In the Common Fox of North America, we meet with a range of color-variation, irrespective of locality, somewhat akin to that seen in *Canis lupus*. The prevalent tendency, however, is toward melanism, which tendency is much more strongly developed in the colder than in the warmer latitudes. Frequently, individuals of the melanistic type occur in litters of the common variety. The varying degrees of melanism occurring in this species have given rise to several commercial varieties, which have received at the hands of naturalists systematic designations, and been regarded more or less generally as valid species. Generally, these melanistic varieties are more fully furred, with larger and heavier tails, than the common form. The difference in the fineness and softness of the fur is recognized to such an extent by furriers as to greatly affect the price of the skins, the so-called "Silver" and "Cross" furs being considered far more valuable than the fulvous type.

The so-called "Cross Fox" (*Vulpes "decussatus"*) is more or less frequent as far south as Northern New England and Northern New York, and throughout the more elevated portions of the great Rocky Mountain plateau, where it constitutes a large proportion of the representatives of the so-called *Vulpes "macrurus"*. More rarely, the Black or so-called "Silver Fox" (*Vulpes "argentatus"*) is met with over the same regions, becoming frequent in the higher parts of the Rocky Mountains* and northward. The fulvous form seems, however, to be generally the more prevalent form throughout the range of the species. To the southward, it is the form exclusively met with; but near timber-line in the Rocky Mountains, and throughout the "fur countries", it seems to be not much more frequent than the melanistic forms.

With this tendency to great variability in color, we meet, as usual in such cases, a great variation in size. In the present case, the variation in color may be properly regarded as geographical, through an increasing tendency to melanism northward. The variation in size is also chiefly of the same character, the size uniformly increasing toward the north, as shown by the subjoined table of measurements. A glance at this table shows at once the nature of this variation. The largest specimens come from the Aleutian Islands and Alaska; the smallest from Essex County, New York, which is the most southerly locality well represented in the collection.

A series of nine skulls from Alaskan localities range in length from 5.70 to 6.20, five out of the nine having a length of 6.00 to 6.20 (two 6.15 and two 6.20), and give an average of 5.98. In another series of eighteen from the Mackenzie River district (mainly from Fort Anderson), the range is from 5.55 to 6.10. Only one, however, exceeds 6.00, and three only reach this size, the average being 5.80. These series consist about equally of the so-called "Silver" and common fulvous varieties, and, as may be seen from the table, there is no material difference in size between the two so-called varieties.

A third series of nine skulls, of the so-called "*macrurus*", chiefly from the Upper Missouri country (including two, however, from the Pacific slope), ranges from 5.40 to 6.00, with an average of 5.75. Two only reach 6.00, and two only fall as low as 5.50. Hence the series forms a third appreciable step in the southward decrease in size. Though the latitude is much less, the elevation of the region is much greater than that of the localities more to the northward. With a similar altitude, the decrease would have been more marked, as is proven by the series

*See Bulletin Essex Institute, vol. vi, p. 54.

next to be considered. A fourth series of twelve specimens, from the Adirondack region of New York, ranges from 5.20 to 5.68, with an average of 5.40. Only three specimens range above 5.50, while four fall below 5.30. A fifth series of five skulls, from European localities, ranges from 5.50 to 5.70, with an average of 5.58.

In the Alaskan series, the width ranges from 2.90 to 3.32, averaging 3.20; in the Mackenzie River district series, from 2.87 to 3.28, averaging 3.02; in the "*macrurus*" series, from 2.70 to 3.20, averaging 2.90; in the Adirondack series, the width ranges from 2.70 to 2.95, averaging 2.80; in the European series, from 3.05 to 3.15, averaging 3.08. Hence—

	Average length.	Average width.
Alaskan series	5.98	3.20, or 0.535 of length.
Mackenzie River District series	5.80	3.02, or 0.521 of length.
"*Macrurus*" series	5.75	2.90, or 0.504 of length.
Adirondack series	5.40	2.80, or 0.518 of length.
European series	5.58	3.08, or 0.552 of length.

It thus appears that in the American specimens there is not only a well-marked southward decrease in size, but also a decrease in the relative breadth of the skull, through the greater elongation of the facial portion; also that the relative breadth is quite appreciably greater in the European form, as noticed long since by Professor Baird.*

While the European *Vulpes vulgaris* may be considered as subspecifically distinct from the American (*Vulpes vulgaris* subsp. *fulvus*), through its wider skull, less pointed and shorter muzzle, harsher and more reddish fur, etc., the different so-called American "species" or "varieties" (*fulvus*, "*decussatus*", "*argentatus*", and "*macrurus*") do not have the same claim to subspecific recognition. The Foxes of the colder regions, it is true, have a fuller and softer pelage, a greater tendency to melanism, shorter muzzles, and are larger, yet these differences are so inconstant, especially the differences of color, and so insensibly intergrade, that any attempt at their subspecific recognition seems impracticable, the most diverse varieties in color occurring at the same localities and even among individuals of the same litter.†

* Mam. N. Amer., pp. 126, 130.

† On this point see Bulletin Mus. Comp. Zoöl., vol. i, pp. 159, 160.

Measurements of fifty-three skulls of VULPES ALOPEX *et vars.*

Catalogue-number.	Locality.	Sex.	Length.	Width.	Remarks.
9481	Kinai, Alaska		6.20	3.03	
8039	Kodiak, Alaska		6.20	3.32	
8037	do		5.90	3.00	
8417	Aleutian Islands		6.15	3.25	
6037	Yukon River	♂	6.15	3.00	Silver.
6039	do	♀	6.00	3.15	Do.
6040	do	♀	5.70	3.05	Do.
6034	do		5.80	3.00	Fulvous.
6035	do		5.70	2.90	Do.
4300	Fort Liard		5.95	3.14	Silver.
6221	Peel River		5.87	3.10	Fulvous.
6038	do		5.95	2.88	Silver.
7175	Fort Good Hope	♂	6.00	3.00	Do.
6221	do		5.90	3.07	Fulvous.
7179	do	♂	5.75	2.94	Silver.
6264	Fort Anderson	♂	6.10	3.28	Black.
1485	do		6.00	3.25	Fulvous.
6262	do	♂	5.95	3.00	Silver.
7186	do		5.80	2.90	Fulvous.
1484	do		5.75	2.95	Do.
6225	do	♀	5.75	3.00	Silver.
1492	do	♂	5.75	3.10	Do.
6263	do	♂	5.66	2.87	Do.
1519	do		5.65	3.00	Fulvous.
6259	do	♂	5.60	3.00	Silver.
6258	do	♂	5.55	2.90	Do.
1518	do		5.55		Fulvous.
11573	Wyoming Territory		6.00	3.20	"*Macrurus.*"
11297	do		6.00	3.00	Do.
11296	do		5.82		Do.
11218	do		5.50	2.78	Do.
7855	Fort Berthold		5.90	3.03	Do.
12909	Fort Randall, Dak		5.65	2.85	Do.
1325	Fort Kearney, Nebr		5.77	2.85	Do.
2014	Fort Dalles, Oreg	♂	5.70	2.83	Do.
4191	Fort Crook, Cal		5.40	2.70	Do.
3078	Essex County, New York		5.65	2.87	
3073	do		5.68	2.85	
3067	do		5.60	2.85	
3719	do		5.50	2.95	
3695	do		5.50	2.87	
3698	do		5.30	2.70	
3709	do		5.30	2.70	
3716	do		5.37	2.75	
3701	do		5.27	2.80	
3715	do		5.25	2.75	
3074	do		5.25	2.73	
3075	do		5.20	2.78	
1038	Sweden		5.70	3.10	
790	England		5.65	3.04	
868	Germany		5.62	3.15	
869	do		5.62	3.05	
870	do		5.50	3.07	

UROCYON VIRGINIANUS.

Measurements of a series of fifteen skulls of this species (all of the available material) form a series grading by slight differences in length from 3.73, the smallest, to 4.77, the largest. The largest specimens are from Pennsylvania, Washington, and Virginia; all these exceed 4.60 in length. The next in size are from Southern Texas and Southern California, which range in length from 4.63 down to 4.50. Next come three specimens from Tehuantepec, Southern Mexico, which range from 4.40 to 4.15. Between these and the next—a series of three "*littoralis*" skulls from the islands off Southern California—is an interval of three-tenths of an inch, the three "*littoralis*" skulls ranging from 3.85 to 3.75. The smallest of all, however, is a single well-matured skull from Merida, Yucatan, 3.73 in length, and hence smaller even than the smallest "*littoralis*" skull, its breadth being only 1.98 against a breadth of 2.05 in the narrowest "*littoralis*" specimen. The localities represented

are few and widely separated; there being no specimens from points between Virginia and Southern Texas, and none between Texas and Tehuantepec, Mexico, nor between these two last-named localities and Fort Tejon, Cal. The small insular race known as "*littoralis*", from the islands off the coast of Southern California, come in between the Tehuantepec specimens and the example from Merida. While there are no very considerable breaks in the chain, the gradation would be more complete if specimens could be included from other intermediate localities. The specimens at hand are sufficient to show a very great but still very gradual decrease in size southward, amounting to over 25 per cent. of the mean size. The mean of the two extremes is 4.25, with a difference of 1.04; while, with a single exception, there is a gap at no point of more than 0.08.

With this rapid decrease in size may be noticed a considerable range of variation in breadth in specimens of nearly the same length, indicating the existence of an unusual amount of individual variation, the ratio of width to length varying from 0.54 to 0.59.

Measurements of fifteen skulls of UROCYON VIRGINIANUS.

Catalogue number.	Locality.	Sex.	Length.	Width.	Remarks.
4729	Pennsylvania	.....	4.77	2.70	
968	Washington, D. C	♀	4.70	2.56	
671	White Sulphur Springs, Va	.....	4.62	2.65	
7491	Washington County, Texas	.....	4.60	2.70	
1175	Eagle Pass, Texas	.....	4.50	2.58	
3543	Fort Tejon, Cal	.....	4.63	2.53	
3545	do	.....	4.55	2.65	
4140	Cape Saint Lucas, Lower California	.....	4.50	2.43	
8659	Tehuantepec, Mexico	.....	4.40	2.35	
8662	do	.....	4.27	2.37	
13851	do	.....	4.15	2.25	
2275	San Miguel Island, California	.....	3.85	2.23	Var. *littoralis*.
2154	San Nicolas Island, California	.....	3.80	2.05	Do.
6323	do	.....	3.75	2.10	Do.
13477	Merida, Yucatan	.....	3.73	1.98	

FELIS CONCOLOR.

The amount of material available for the study of variation in size with locality in the present species is too small to yield very satisfactory results. In the eight specimens of which measurements are given below, it will be noticed that there is a decided increase in size southward. Between the three skulls from northern localities (one each from Northern New York and Washington and Oregon Territories) and the three (mature) skulls from southern localities (Louisiana and the Rio Grande, Texas), the average difference is fully an inch, or about one-eighth of the mean size.

Measurements of eight skulls of FELIS CONCOLOR.

Catalogue-number.	Locality.	Sex.	Length.	Width.	Remarks.
3811	Essex County, New York	.....	7.40	5.25	Old.
8597	Puget Sound	.....	7.50	5.05	
3267	Oregon	.....	7.80	5.15	
1148	Eagle Pass, Texas	.....	7.75	4.95	Quite immature.
1356	Rio Grande, Texas	.....	7.50	5.00	Do.
1355	.....do	.....	8.40	5.35	
1895	Brazos River, Texas	.....	8.50	5.60	
1158	Prairie Mer Rouge, Louisiana	.....	8.75	5.50	

FELIS PARDALIS.

Fourteen skulls of *Felis pardalis* show a most decided southward increase in size. A series of five skulls from the Lower Rio Grande average about an inch shorter than another series of nine from Southern Mexico and Central America. The largest of the Rio Grande skulls has a length of 5.25, while the smallest of the Mexican and Central American series (excluding one rather young specimen) has a length of 5.20, and the largest a length of 6.20. The three largest (6.00 to 6.25) are from Costa Rica, while one other from Panama and another from Surinam are but little smaller. The smallest of the Rio Grande series (a rather young specimen) is but 4.50 in length; the smallest of the tropical series (a specimen of corresponding age) 5.35.

The difference in size with locality is thus as great in this species and in *Felis concolor* as it is in the Wolves and Foxes; but the increase is in the opposite direction,—to the *northward* in the former and to the *southward* in the latter; the one group being a northern type, the other a tropical.

Measurements of fourteen skulls of FELIS PARDALIS.

Catalogue-number.	Locality.	Sex.	Length.	Width.	Remarks.
1363	Matamoras, Mexico	.....	4.50	3.05	Mature but not very old.
1362	.....do	.....	4.90	3.35	
1361	.....do	.....	5.05	3.35	
1359	.....do	.....	5.20	3.50	
1358	.....do	.....	5.25	3.40	
6023	Panama	.....	5.60	3.75	
7080	Mirador, Mexico	.....	5.70	3.55	
13859	Tehuantepec, Mexico	.....	5.50	3.70	
11743	Isthmus of Darien	.....	5.85	3.80	
14182	Costa Rica	.....	6.00	3.73	Very old.
14179	.....do	.....	6.00	3.94	Do.
14180	.....do	.....	6.20	4.19	Do.
14178	.....do	.....	5.35	3.60	Adult but not very old.
13005	Surinam	.....	5.80	3.83	Very old.

LYNX RUFUS ET LYNX CANADENSIS.

In the subjoined table are given measurements of thirty-four skulls of North American Lynxes, namely, seven of *L. fasciatus*, ten of *L. rufus*, eight of *L. maculatus*, and nine of *L. canadensis*, representing localities as distant from each other as Alaska and Northern Mexico on the one hand, and New York and Fort Tejon, Cal., on the other. Yet the

extremes of variation met with at single localities are as great as those from the most widely separated of the above-named localities; in other words, no geographical variation in size is perceptible. The largest northern specimen (*canadensis*), from Peel River, Arctic America, with a length of 5.30, a little exceeds in size the largest specimens from any locality south of the latitude of 40°; but it in turn is slightly smaller than a specimen (*fasciatus*) from Fort Townsend, Wash., which has a length of 5.50, and by another of the same dimensions (*rufus*) from the Big Sioux River. Eight specimens of the most southern type (*L. maculatus*), all from Texas and the Mexican side of the Lower Rio Grande, differ in the average from nine specimens of the most northern type (*L. canadensis*), all from Arctic or sub-Arctic America, almost inappreciably, the *canadensis* series having an average length of 5.01 and the *maculatus* series of 5.00! The difference in breadth is also only about one-tenth of an inch, which the addition of a single specimen to either series might cancel. This is certainly a surprising result when it is remembered that one of the chief alleged distinctive characters of *L. canadensis* has been its supposed larger size!

The average dimensions of these several series are as follows:

Species.	Number of specimens.	Length.	Breadth.
L. canadensis	9	5.01	3.38
L. fasciatus	7	5.03	3.56
L. maculatus	8	5.00	3.40
**L. rufus*	10	4.91	3.41
Mean of all	34	4.98	3.47

* The specimens placed under *rufus* are those that are so marked in the collection, being the specimens so identified by Professor Baird.

The *fasciatus* series is the largest, but this series happens to include more very old specimens than the others, and hence its higher average. Such a constancy of size as is here shown to prevail over an area embracing more than 40 degrees of latitude is probably without a parallel in any other conspecific group of North American Mammals.

The difference between these heretofore commonly-recognized "species" of the genus *Lynx* must hence be sought elsewhere than in size. The specific distinctness of *L. canadensis*, the most northern type, has been heretofore scarcely questioned, in consequence of its supposed larger size, larger limbs, longer, softer pelage, longer ear-tufts, more indistinct markings, and generally lighter or grayer color. The longer ear-tufts correlate with the longer, softer pelage, that always characterizes the boreal representatives of species having a wide latitudinal range. The difference in coloration is not greater than, or even so great as, that which obtains between *fasciatus* and *rufus*, or between *fasciatus* and *maculatus*, which forms naturalists now seem disposed to refer to one and the same species under the name *L. rufus*. *Maculatus*, the most southern form, differs from the "typical" or eastern *rufus* in its shorter, coarser fur, more reddish tints, and more distinct markings. Its reputed range extends from the Lower Rio Grande westward across the continent to Southern California; but in the National Museum collection are also specimens marked *rufus* from many points within this area, including a considerable series from Fort Tejon. The gradation from the "typical" *rufus* type into *maculatus* is complete and by almost insensible stages.

The *L. fasciatus* or Columbia River race differs from *rufus* in its more uniform and darker (chestnut rather than reddish) coloration, by the markings on the dorsal surface and sides of the body being nearly obsolete, and the fuller, softer fur, which is about as heavy and soft as in *canadensis*. We have hence, in this form, only another instance of the duller, darker, and more uniform coloration that characterizes the greater part of the Mammals (and many Birds also) from the humid, heavily-wooded Columbia River region, as compared with their conspecific allies of the other portions of the continent.

L. canadensis differs from these several southern races mainly as the northern representatives of a given species usually differ from its southern representatives, namely, in its softer and longer pelage, more heavily-clothed feet, longer ear-tufts, paler or grayer general color, and more indistinct markings, and especially in a tendency to entire obsolescence of the markings on the lower surface of the body and inner side of the legs. The tail has a shorter area of black at the end, and lacks the white on the lower surface at the extreme tip, so constantly seen in the other forms. The tail is but little, if any, shorter, although the greater length and thickness of the fur give it that appearance. There is, however, a tendency to a greater length of tail to the southward. Its supposed greater size and larger limbs are also due almost wholly to the greater fullness and length of the pelage, the fresh carcass (in a specimen from Houlton, Me.) with the skin removed giving the same measurements as in *L. rufus* (a specimen from Colorado).

The prior name for the group of American Lynxes is undoubtedly *rufus* of Guldenstädt (1776), which antedates by about forty years Rafinesque's names of *canadensis*, *montanus*, and *floridanus* (1817). The *L. maculatus* of Horsfield and Vigors (1829), which was admitted as a valid species by Baird, but regarded as merely a variety of *rufus* by Audubon and Bachman, is evidently subspecifically indistinguishable from the true *rufus* of authors. *L. fasciatus* of Rafinesque (based on the "Tiger Cat" of Lewis and Clarke, from the Columbia River region) is far more tangible, sufficiently so to be properly recognizable as a subspecies (*Lynx rufus* subsp. *fasciatus*). The *L. canadensis* of authors seems to have even still stronger claims for nominal recognition, though the differences are still clearly such as characterize geographical races. We hence believe its relationship to the rest of the group is better indicated by a name (*L. rufus* subsp. *canadensis*) indicating subspecific rather than specific rank.

A single adult skull (from Sweden) of the large Lynx of the northern parts of the Old World (*Lynx borealis*) exceeds in size by an inch the largest specimens of the American Lynxes, and hence seems to indicate an animal fully one-fifth larger than even exceptionally large specimens of *L. rufus*.

Measurements of thirty-four skulls of LYNX RUFUS *et vars.*

Catalogue number.	Locality.	Sex.	Length.	Width.	Remarks.
8599	Puget Sound, Wash	.....	4.80	3.45	"*fasciatus.*"
8600	.....do	.....	4.65	3.30	Do.
3426	Steilacoom, Wash	♀	5.20	3.60	Do. Very old.
3197	.....do	.....	5.45	3.95	Do.
3427	Fort Umpqua, Wash	.....	.....	3.32	Do.
3426	.....do	.....	4.90	3.50	Do.
2032	Shoalwater Bay, Wash	.....	4.75	.....	Do.
3147	Fort Townsend, Wash	.....	5.50	3.82	Do. Very old.
2883	Big Sioux River	♀	5.50	3.82	"*rufus.*" Very old.
3775	Mississippi	.....	4.95	3.38	Do.
7465	Arizona	.....	5.10	3.55	Do.
3120	Florida	.....	4.85	3.22	Do. Quite young.
2391	Louisiana	.....	4.90	3.27	Do.
3574	Fort Tejon, Cal	♂	4.80	3.32	Do.
3542	.....do	.....	4.80	3.50	Do.
3541	.....do	♂	4.93	3.38	Do.
3570	.....do	.....	4.65	3.37	Do.
3576	.....do	.....	4.65	3.37	Do.
1887	Fort Belknap, Tex	.....	5.12	3.72	"*maculatus.*"
1109	Eagle Pass, Texas	.....	5.27	3.51	Do.
7493	Washington County, Texas	.....	4.72	3.25	Do.
1376	Matamoras, Mexico	.....	4.55	3.10	Do. Rather young.
1367	.....do	.....	5.10	3.40	Do.
1368	.....do	.....	4.80	3.25	Do.
1006	Texas	.....	5.15	3.57	Do.
1159	Prairie Mer Rouge, Louisiana	.....	4.80	3.28	Do.
9478	Kinai, Alaska	.....	4.85	3.35	"*canadensis.*"
6031	Yukon, Alaska	.....	4.95	3.53	Do.
6030	.....do	♀	4.75	3.35	Do.
6216	Peel River	♀	4.95	3.53	Do.
6211	.....do	♂	5.30	3.70	Do.
4468	Fort Simpson	.....	5.15	3.60	Do.
4296	Liard River	.....	5.00	3.45	Do.
3979	Red River Settlement	.....	5.00	3.52	Do.
2570	Medicine Bow Creek, Wyoming	.....	5.15	3.60	Do.

PROCYON LOTOR.

The present species presents another well-marked case of gradual increase in size southward. In a series of fifteen skulls from the Atlantic States (New York, Pennsylvania, and Georgia), only a single specimen exceeds 4.38 in length or 3.00 in width, the largest specimen being from Saint Simon's Island, Georgia. Three from Essex County, New York, average 4.28; five from Pennsylvania average 4.29; seven from Saint Simon's Island, Georgia, average 4.26 (or 4.29, excluding one very small one). Six specimens from the interior (Nebraska, Missouri, Indian Territory, and the Lower Rio Grande) average 4.49, two only falling below 4.50, and the largest (Rio Grande) 4.70. Three from California ("*hernandezi*") average 4.63, the largest reaching 4.78, with a width of 3.38. Six from Southern Mexico average 4.58, the largest reaching 4.73 in length, with a width of 3.42. Three from Costa Rica average 4.69, the largest reaching 4.85.

In addition to the above, there is a single very aged specimen from Detroit, Mich., which has a length of 4.35, and two others from Alaska (one middle-aged, the other rather young) which measure, respectively, 4.25 and 4.05 in length, the latter being the smallest of the whole series, although it contains others equally young.

Between the three specimens from Essex County, New York, and the three from Costa Rica, specimens of corresponding ages and constituting the two extremes, the average difference is nearly six-tenths (0.57) of an inch, or about one-seventh of the size of the northern examples.

Besides the difference in size, there is also a considerable range of variation in respect to the general form of the skull in the ratio of width to length, in the shape, degree of concavity of the palate, in specimens

from the same locality, the ratio of width to length varying from 0.65 to 0.73.

In addition to the increase in size southward, there is a tendency to an increase in the intensity of the colors in the same direction, with a stronger contrast between the light and dark markings. These differences, taken collectively, have given rise to several nominal species, of which the *P. hernandezi* of Wagler and *P. psora* of Gray have become the most prominent. The species normally presents a considerable range of color-variation, tending on the one hand more or less to melanism and on the other to albinism. On these extreme phases of coloration have also been based other nominal species, as the *P. obscurus* of Wiegmann and the *P. nivea* of Gray. All these names have been already placed by Gray, in his later notices of the group, under the head of *P. lotor*, but separated as being varietally distinct. It seems doubtful, however, whether even the large southern form, usually called *hernandezi*, is really entitled to subspecific recognition.

Measurements of thirty-six skulls of PROCYON LOTOR.

Catalogue number.	Locality.	Sex.	Length.	Width.	Remarks.
8690	Alaska	.....	4.25	2.87	Middle-aged.
8693	.....do	.....	4.05	2.92	Young.
1068	Detroit, Mich	.....	4.35	.....	Very old.
3723	Essex County, New York	.....	4.25	2.87	Do.
3722	.....do	.....	4.27	2.70	Middle-aged.
3079	.....do	.....	4.32	3.00	Very old.
898	Pennsylvania	.....	4.35	3.00	Do.
6025	.....do	.....	4.12	2.51	Do.
4817	.....do	.....	4.38	2.64	Do.
575	.....do	.....	4.25	2.88	Do.
766	.....do	.....	4.35	2.93	Do.
2443	Saint Simon's Island, Georgia	.....	4.25	2.62	Middle-aged.
2437	.....do	.....	4.38	3.03	Very old.
2447	.....do	.....	4.06	2.65	Do.
2450	.....do	.....	4.30	2.87	Do.
2444	.....do	.....	4.12	.....	Do.
2446	.....do	.....	4.12	2.90	Do.
2202	.....do	.....	4.57	3.00	Do.
8649	Nebraska	.....	4.50	3.07	Do.
8085	Fort Cobb, Indian Ter	.....	4.50	3.03	Do.
3325	Independence, Mo	.....	4.23	2.78	Young.
7739	Long Point, Tex	.....	4.32	2.98	Old.
1386	Lower Rio Grande	.....	4.52	2.90	Young.
1387	.....do	.....	4.70	3.15	Old.
3294	San Francisco, Cal	.....	4.42	.....	Very old; "*hernandezi*."
3933	Sacramento, Cal	.....	4.78	3.38	Do.
13312	California	.....	4.70	3.12	Very old.
7081	Mirador, Mexico	.....	4.75	3.15	Middle-aged.
6119	Colima, Mexico	.....	4.50	3.33	Old.
6481	.....do	.....	4.46	3.15	Middle-aged.
9706	Tehuantepec, Mexico	.....	4.50	2.83	Young.
13853	.....do	.....	4.52	.....	Old.
13854	.....do	.....	4.73	3.42	Very old.
13300	Costa Rica	.....	4.55	3.03	Middle-aged.
14190	.....do	.....	4.78	3.32	Old.
14191	.....do	.....	4.85	3.00	Do.

PUTORIUS VISON.

Eighteen skulls from the northern parts of the continent, mainly from Alaska, average 2.66 in length and 1.58 in width, the extremes being, length, 3.02 and 2.30; width, 1.90 and 1.40. Thirteen skulls from the highlands of Northeastern New York average 2.40 in length and 1.34 in width, the extremes being, length, 2.60 and 2.17. Three skulls from Pennsylvania (undoubtedly males) average 2.49 in length and 1.48 in width. In the northern series, the sex of the skull is given by the collector, whence it appears that the twelve males have an average

length of 2.81, and the six females an average length of 2.48, showing a considerable sexual variation in size. Yet the smallest males (2.64 and 2.63) fall below the largest female (2.68), if the skulls are all correctly marked. None of the other females, however, exceed 2.55, and only three of the males fall below 2.70. In the New York series, the sex is not indicated; but, judging from the proportion of the small to the large skulls, the sexes are about equally represented in the two series, but in the New York series there is a very gradual decline from the largest to the smallest. The northern series of eighteen is selected from a series of twenty-three; the New York series of thirteen from a series of thirty. In each case only very old skulls were chosen, the immature specimens in each case being thrown out in order to have a fair basis for comparison. The immature and middle-aged specimens greatly predominate in the New York series, owing, doubtless, to the species being more closely hunted there than in the more unsettled districts of the far north.

Taking these two series as a basis for a general comparison, there is indicated a considerable decrease in size from the north southward, amounting to 0.26 in length and 0.24 in width, or about one-tenth of the average size of the New York series. A single specimen, marked "Brookhaven, Miss.", and another marked "Tuscaloosa, Ala.", however, have a length respectively of 2.60 and 2.80, the former equaling the largest New York specimens, and the latter nearly equaling the average size of the males of the northern series, while a single male skull from Fort Randall, D. T., 2.90 in length, is the second in size of the whole series; one Fort Yukon specimen only being larger! Other specimens from the Upper Missouri region, however, are much smaller, as are other specimens from Prairie Mer Rouge, La., indicating that the specimens above mentioned are much above the average for their respective localities.

Measurements of thirty-seven skulls of PUTORIUS VISON.

Catalogue number.	Locality.	Sex.	Length.	Width.	Remarks.
6530	Fort Yukon, Alaska	♂	3.02	1.90	Very old.
8709	Alaska	♂	2.82	1.64	Do.
8797	do	♂	2.83	1.62	Do.
8796	do	♂	2.75	1.61	Do.
8707	do	♂	2.73	1.62	Do.
8703	do	♂	2.75	1.57	Do.
8702	do	♂	2.68	1.62	Do.
8798	do	♂	2.64	1.55	Do.
8648	Alaska (Kadiak)	♂	2.63	1.52	Do.
8708	Alaska	♀	2.62	1.58	Do.
6531	do	♀	2.55	1.50	Do.
8704	do	♀	2.45	1.45	Do.
8706	do	♀	2.32	1.40	Do.
8705	do	♀	2.30	1.40	Do.
3284	Nelson River	♂	2.86	1.62	Do.
4339	Fort Simpson	♂	2.70	1.51	Do.
8133	do	♂	2.90	1.78	Do.
4305	do	♀	2.55	1.46	Do.
12915	Fort Randall	.....	2.90	1.61	Do.
3730	Essex County, New York	.....	2.60	1.48	Old.
3824	do	.....	2.60	1.38	Do.
1169	do	.....	2.40	1.32	Old. *P.* "*nigrescens*" A. & B.
3085	do	.....	2.40	1.38	Do.
3084	do	.....	2.40	1.31	Do.
3823	do	.....	2.32	1.32	Old.
3822	do	.....	2.30	1.23	Do.
2242	Saranac Lake, New York	.....	2.47	1.37	Do.
2243	do	.....	2.40	1.30	Do.
2241	do	.....	2.35	1.31	Do.
2244	do	.....	2.20	1.18	Do.
2250	do	.....	2.40	1.48	Do.
2267	do	.....	2.17	1.20	Do.
1847	Pennsylvania	.....	2.50	1.48	Do.
4834	do	.....	2.50	1.48	Do.
4835	do	.....	2.47	1.48	Do.
1894	Tuscaloosa, Ala	.....	2.80	1.61	Do.
11315	Brookhaven, Miss	.....	2.60	1.50	Do.

MUSTELA AMERICANA.

The forty-six male skulls of this species, of which measurements are given below, are mainly from four or five localities differing widely in latitude. A comparison of the average size of a considerable number from each shows a well-marked decrease in size southward. Four skulls from Peel River, the largest, and also from the most northerly locality, have an average length of 3.39, and an average width of 2.07, the extremes being 3.50 and 3.35 in length and 2.12 and 2.02 in width. Nine skulls from the Yukon (probably mostly from near Fort Yukon) give an average length of 3.34 and an average width of 1.98, the extremes being 3.55 and 3.00 in length and 2.15 and 1.73 in width. Five skulls from Fort Good Hope give an average length of 3.24 and an average width of 1.95, the extremes in length being 3.37 and 3.15 and in width 2.05 and 1.73. Ten skulls from the northern shore of Lake Superior average 3.14 in length and 1.76 in width, the extremes in length being 2.23 and 3.02 and in width 1.89 and 165. Eight skulls from the vicinity of Umbagog Lake, Maine (Coll. Mus. Comp. Zoöl.), average 2.96 in length and 1.72 in width, the extremes in length being 3.10 and 2.73, and in width 1.85 and 1.50. Five skulls from Northeastern New York average 3.02 in length and 1.61 in width, the extremes being in length 3.10 and 2.92 and in width 1.68 and 1.50. There is thus a gradual descent in the average length from 3.39 to 3.02, and in width from 2.07 to 1.61. The largest and the smallest of the series are respectively 3.55 and 2.92 in length. Several fall as low as 3.00, and an equal number attain 3.50. The difference between the

largest and the smallest, excluding the most extreme examples, is one-sixth of the dimensions of the smaller and one-seventh of the size of the larger.

The sexes differ considerably in size, relatively about the same as in *Putorius vison*; but the above generalizations are based wholly on males, and in each case on those of practically the same age, only specimens indicating mature or advanced age being used.

The series of fully one hundred skulls of this species contained in the National Museum presents a considerable range of variation in details of structure, involving the general form of the skull, the relative size of different parts, and the dentition, especially the form and relative size of the last molar. In a former paper,* I had occasion to notice somewhat in detail the variations in color our American Martens present, and the difficulty of finding any features of coloration that seemed to indicate more than a single American species, or that would serve to distinguish this even from the Martens of the Old World. Dr. J. E. Gray, it is true, had already called attention to the small size of the last molar in the American Martens as compared with the size of the same tooth in the Old World Martens; but, as his observation was apparently based on a single American skull, and as I was at the time strongly impressed with the wide range of individual variation I had found in allied groups, even in dental characters, and also with the great frequency of Dr. Gray's characters failing to be distinctive, I was misled into supposing all the Martens might belong to a single circumpolar species, with several more or less strongly-marked geographical races. My friend Dr. Coues some months since kindly called my attention to the validity of Dr. Gray's alleged difference in respect to the size and form of the last molar, which I have since had opportunity of testing. This character alone, however, fails to distinguish *Mustela foina* from *Mustela americana*, in which the last molar is alike, or so nearly so that it fails to furnish distinctive differences. The size and general form of the skull in the two are also the same, the shape of the skull and the form of the last upper molar failing to be diagnostic. The second lower true molar, however, in *Mustela foina* presents a character (shared by all the Old World Martens) which serves to distinguish it from *Mustela americana*, namely, the presence of an inner cusp not found in the latter. In *Mustela flavigula*, the last molar is relatively *smaller* than even in *Mustela americana*, and of the same form. *Mustela martes* differs in its more massive dentition and in the heavier structure of the skull, but especially in the large size of the last molar and the very great development of its inner portion. Hence, while the size and shape of the last upper molar serves to distinguish *Mustela martes* from *Mustela americana*, it fails as a valid distinction between *Mustela americana* and *Mustela flavigula* and *Mustela foina*. As already remarked, however, *Mustela americana* lacks the inner cusp of the second lower molar, which is present in the Old World Martens, or at least possesses it only in a very rudimentary condition.

* "Mammals of Massachusetts", Bull. Mus. Comp. Zoöl., vol. i, pp. 161–167, Oct., 1869

Measurements of forty-six skulls of MUSTELA AMERICANA.

Catalogue number.	Locality.	Sex.	Length.	Width.	Remarks.
6043	Yukon River	♂	3.55	2.15	
6049	.....do	♂	3.50	1.85	
6085	.....do	♂	3.45	1.83	
6047	.....do	♂	3.37	1.82	
6044	.....do	♂	3.30	1.85	
6051	.....do	♂	3.00	1.73	
6048	.....do	♂	3.28	.....	Imperfect.
6046	.....do	♂	3.28	1.82	
9099	Kenai, Alaska	♂	3.30	2.03	
7159	Fort Good Hope	♂	3.37	2.05	
7167	.....do	♂	3.25	1.98	
7168	.....do	♂	3.25	1.93	
7164	.....do	♂	3.25	1.76	
7163	.....do	♂	3.15	1.73	
6081	Peel River	♂	3.50	2.02	
6080	.....do	♂	3.37	2.12	
6063	.....do	♂	3.35	.....	Imperfect.
6059	.....do	♂	3.35	.....	Do.
3285	Red River	♂	3.40	1.94	
4670	Lake Superior (north shore)	♂	3.23	1.75	
4668	.....do	♂	3.18	1.65	
4664	.....do	♂	3.15	1.65	
4668	.....do	♂	3.16	1.65	
4666	.....do	♂	3.15	1.87	
4675	.....do	♂	3.15	1.83	
4674	.....do	♂	3.15	1.85	
4667	.....do	♂	3.10	1.89	
4672	.....do	♂	3.12	1.65	
4681	.....do	♂	3.02	1.83	
	Washington Territory	♂	3.23	1.90	
	.....do	.....	3.15	1.72	Rather young.
	.....do	.....	3.03	1.55	Do.
	.....do	.....	3.00	.....	Do.
1668	Essex County, New York	♂	3.10	1.57	
1163	.....do	♂	3.03	1.63	
3819	.....do	♂	3.00	1.68	
3818	.....do	♂	2.92	1.50	
2245	Saranac Lake, New York	♂	3.03	1.68	
541	Umbagog Lake, Maine	♂	3.10	1.85	
550	.....do	♂	3.00	1.70	
542	.....do	♂	3.00	1.72	
552	.....do	♂	3.00	1.72	
553	.....do	♂	3.00	1.78	
543	.....do	♂	2.90	1.78	
545	.....do	♂	2.92	1.68	
544	.....do	♂	2.73	1.50	

TAXIDEA AMERICANA.

The subjoined measurements of eleven skulls of this species (embracing all at present available) show also a well-marked southward decrease in size. A fuller series would be more satisfactory, but would doubtless only confirm what is here indicated. Six of the specimens are from rather northern localities and five from rather southern localities, the region represented extending from the Upper Missouri southward to the Lower Rio Grande. The specimens composing the two series are of very nearly corresponding ages. The northern series (four from different points on the Upper Missouri, one from Iowa, and one from Oregon) average 5.00 in length and 3.18 in width, the extremes being, in length, 5.22 and 4.92 (4.75 if we include one rather young example), the width ranging from 3.50 to 2.97. The southern series (including two or three from the vicinity of Matamoras, Mexico, and one each from New Mexico and California) averages 4.62 in length and 2.92 in width, the extremes being, in length, 4.75 and 4.50, and in width, 3.07 and 2.80.

The skulls, and especially the molar teeth, in the American Badgers, vary considerably in different individuals, as long since pointed out by

Professor Baird.* Southern specimens differ from northern ones not only in being smaller, but somewhat in color, so that the *T. berlandieri* of Professor Baird may perhaps be entitled to subspecific rank (*T. americana* subsp. *berlandieri*), though the material at hand indicates that the two forms will be found to thoroughly intergrade. The chief differences in coloration consist in the more reddish-gray tint of the southern form, with a decided tendency to a continuous light dorsal stripe, instead of this stripe being restricted to the head.

Measurements of eleven skulls of TAXIDEA AMERICANA.

Catalogue number.	Locality.	Sex.	Length.	Width.	Remarks.
11505	Upper Missouri	.....	5.22	3.50	
1178	.....do	.....	5.12	3.12	
2148	.....do	.....	4.75	3.07	Rather young.
2078	Quisquaton, Iowa	.....	5.06	.....	Imperfect.
12908	Fort Randall, Dak	.....	4.95	3.25	
2033	Upper Des Chutes, Oreg	.....	4.92	2.97	
4196	Fort Crook, Cal	.....	4.60	3.07	
3767	New Mexico	.....	4.50	2.80	Rather young; *berlandieri.*
1390	Matamoras, Mexico	.....	4.75	2.94	*berlandieri.*
	.....do	.....	4.66	2.85	Do.
4135	Texas	.....	4.57	2.94	Do.

LUTRA CANADENSIS.

Specimens of this species from northern and southern localities do not differ materially in size; skulls from Newfoundland, Maine, Lake Superior, Washington, and Georgia agreeing very closely in dimensions. In a series of eighteen (mainly from northern localities), nine attain or exceed a length of 4.25, and three reach 4.50, while two only fall as low as 4.00. Seven specimens from the vicinity of Lake Umbagog, Maine, (in Mus. Comp. Zoöl.) average 4.28 in length and 2.93 in width; two of these reach 4.50 in length and two fall slightly below 4.00 (3.96 and 3.97). Two specimens from Washington, D. C., have a length respectively of 4.45 and 4.50; one specimen from Saint Simon's Island, Georgia, is nearly as large (4.32), while a Fort Cobb specimen has a length of 4.22. These four are the only ones from very southerly points. Four other specimens, from as many localities, range from 4.05 to 4.15; while three specimens from Newfoundland range from 4.03 to 4.25. While these specimens are too few to warrant positive conclusions as to geographical variations, they seem to point to a great constancy of size throughout a wide range of latitude.

* U. S. and Mex. Bound. Survey, Zoöl., p. 21.

Measurements of eighteen skulls of LUTRA CANADENSIS.

Catalogue-number.	Locality.	Sex.	Length.	Width.	Remarks.
501	Newfoundland		4.90	2.75	
498	do		4.03	2.53	
500	do		4.15	2.57	
490	do		4.35	2.90	
555	Umbagog Lake, Maine		4.40	3.00	
556	do		4.27	2.85	
557	do		4.50	2.90	
559	do		3.97	2.70	
558	do		3.96	2.70	
489	do		4.50	3.00	
4446	Lake Superior		4.15	2.85	
11839	Fort Berthold, Dak		4.25	2.82	
2247	Saranac Lake, New York		4.05	2.57	
13671	Bayfield, Wis		4.06	2.82	
8097	Fort Cobb, Indian Ter		4.22	2.87	
	Washington, D. C		4.50	2.95	
433	do		4.45		Imperfect.
3142	Saint Simon's Island, Georgia		4.32	2.75	

MEPHITIS MEPHITICA.

The twenty-nine skulls of this species of which measurements are given below show a wide range of variation in size, and a decided decrease southward. The localities embrace such distant points as California and the Atlantic seaboard on the one hand, and Maine and Texas on the other; but, with one or two exceptions, the specimens from any single locality are unsatisfactorily few. The specimens range in length from 2.60 to 3.50, and in width from 1.60 to 2.25! Yet there is not a specimen included in the series that is not so old as to have all the cranial sutures obliterated. A portion of the difference is doubtless sexual, but the specimens, unfortunately, have not the sex indicated. Ten of the specimens may be considered as western, coming mainly from Utah and California; ten others are from Maine and Massachusetts, and one from Northeastern New York; three are from Pennsylvania; and of the remaining five, four are from Texas, and one from Louisiana. The western series of ten average 3.10 in length and 1.95 in width, ranging in length from 2.85 to 3.50 and in width from 1.70 to 2.25. The New England series of ten average 2.88 in length and 1.72 in width, ranging in length from 2.70 to 3.25 and in width from 1.53 to 1.85. The single New York specimen scarcely varies from the average of the New England series, while the Pennsylvania specimens fall a little below. The five southern specimens average 2.73 in length, or a little below the New England series, ranging in length from 2.60 to 290.*

It thus appears that the western specimens are decidedly the largest of all, and that the northern are somewhat larger than the southern, the specimens compared being of corresponding ages, though of unknown sex, but doubtless comparable in this respect also.

The difference in size amounts to above one-fourth the size of the largest specimen and above one-third the size of the smallest. Between the western and southern series, the average difference amounts to one-third of the average size of the larger series! The western series includes the so-called *Mephitis occidentalis* of Baird, based on California specimens, and whose chief difference is merely that of larger size; yet the four specimens from Ogden, Utah (Coll. Mus. Comp. Zoöl.), considerably

* The range in width is not fairly indicated, owing to two of the smaller specimens being imperfect.

excelled in size the three from California. The southern series represents the so-called *M. varians* of Gray and Baird.

The unsatisfactory character of the several species of North American Skunks of the *mephitica* group, and the wide range of color-variation among individuals from the same locality, I have previously had occasion to notice,* and a re-examination of the subject confirms the conclusions then announced, which, I am happy to find, have recently received the support of Dr. Coues, who has lately made a study of this group.† As Dr. Coues has remarked, and as the subjoined measurements show, few species of animals vary so much in size and in cranial characters as the present, independently even of sex and age. Some specimens are not only more than one-fourth larger than others, but "there is a corresponding range of variation in contour. Compared with an ordinary ratio of osteological variability," says Dr. Coues, "the discrepancies are almost on a par with those exhibited by the coloration of the animal when set over against the more constant markings of most animals." In view of this great degree of variability, however, Dr. Coues has ventured to describe a "new species" (*M. frontata*), based on a fossil skull from one of the bone-caves of Pennsylvania, as it seems to me, unadvisedly. The specimen, though that of a very aged individual, is scarcely larger (see subjoined table) than the average of specimens from the Eastern States, its chief difference from the average skull consisting in an abnormal tumidity of the frontal region, arising evidently from disease. It is a feature by no means confined to the present example, but is merely an extreme enlargement of the sinuses of the frontal region often seen in specimens of the existing animal, evidently resulting from disease. In No. 917 (Albany, N. Y.), No. 8099 (Fort Cobb, Ind. T.), No. 1878 (Calcasieu Pass, La.), and No. 1620 (Indianola, Tex.), the same tendency is strongly marked, which, in some of these specimens, had they attained equal age, must have resulted in a malformation nearly or quite as great as is seen in the fossil skull in question.

In this connection, I may add that a pretty careful examination of the fossil remains of *Carnivora*, collected by Professor Baird many years since from the bone-caves of Pennsylvania (of which this fossil skull of the Skunk forms a part), has failed to show any of them to be specifically different from the species now or recently living in the same region. Many of them are remains of individuals of large size, but not exceeding the dimensions of specimens of the recent animal from the same or contiguous regions. These remains include, among others, the following species:—*Lynx rufus*, *Urocyon virginianus*, *Mustela pennanti*, *Mustela americana*, *Putorius vison*, *Lutra canadensis*, *Mephitis mephitica* (other specimens than the "*frontata*" skull), *Procyon lotor*, *Ursus americanus*, etc.

* See Bull. Mus. Comp. Zoöl., vol. i, pp. 178–181, Oct., 1869.

† Bull. U. S. Geol. and Geog. Surv. of the Territories, vol. i, No. 1, pp. 7–15, 1875.

Measurements of twenty-nine skulls of MEPHITIS MEPHITICA.

Catalogue number.	Locality.	Sex.	Length.	Width.	Remarks.
2617	Petaluma, Cal	.....	3.30	2.07	
3271	.....do	.....	3.08	2.04	
2434	Port Townsend, Oreg	.....	2.93	1.70	
4195	Fort Crook, Cal	.....	2.85	.....	
417	Ogden, Utah	.....	3.12	1.87	
419	.....do	.....	3.50	2.25	Very old.
416	.....do	.....	3.10	1.90	
418	.....do	.....	2.98	1.85	
10008	Wyoming Territory	.....	3.15	2.05	
3327	Fort Laramie	.....	2.96	1.78	
575	Upton, Me	.....	3.25	.....	Very old.
580	.....do	.....	3.00	1.85	
577	.....do	.....	2.87	1.75	
574	.....do	.....	2.85	1.73	
583	Norway, Me	.....	2.90	1.75	
578	.....do	.....	2.70	1.70	
569	.....do	.....	2.87	1.78	
567	Massachusetts	.....	2.70	1.53	
568	.....do	.....	2.75	.....	
576	.....do	.....	2.72	1.70	
3816	Essex County, New York	.....	2.88	1.78	
2232	Bone-caves, Pennsylvania	.....	2.90	.....	Fossil; *M. frontata* Cones.
610	Carlisle, Pa	.....	2.87	.....	Imperfect.
4833	Chester County, Pennsylvania	.....	2.60	1.65	
1620	Indianola, Tex	.....	2.80	1.78	
1004	Eagle Pass, Tex	.....	2.60	.....	Imperfect.
1113	.....do	.....	2.68	1.60	
1395	Matamoras, Tex	.....	2.90	1.90	
1878	Calcasieu, La	.....	2.68	.....	Imperfect.

URSUS ARCTOS, ET VARS.

In a series of seventeen rather aged skulls of *Ursus arctos* and its varieties (all but one of the specimens being American), the largest specimens are from California, the great metropolis of the "Grizzlies". Of the eight skulls from this State, five attain a length of 14.50 or more, three exceeding 15.00, and one reaching 15.60, while the smallest falls as low as 13.25. Of five specimens from different localities in the Rocky Mountains, three reach or exceed 14.40, the extremes being 14.75 and 13.25. Of three specimens from the Arctic coast, one has a length of 13.40, and the others respectively 12.40 and 12.35. A single specimen from Russia has a length of 13.75. These I regard as being all unquestionably conspecific, though perhaps referable to two or three subspecies. Whether strictly so or not, we have the fact of the culmination in size in the region where the Grizzlies are most abundant, namely, in California; these two facts, greatest abundance and largest size, seeming to indicate this region as presenting the most favorable conditions for the existence of these animals. The Rocky Mountain specimens average considerably smaller than the Californian; and though the species is pretty frequent here it is far less abundant than on the Pacific slope, especially in California and Oregon. The Franklin Bay specimens, representing the so-called "Barren Ground Bear", and indistinguishable from the true *arctos* of the Old World, are smaller even than the specimens from the Rocky Mountains.

Measurements of seventeen skulls of URSUS ARCTOS (*chiefly subsp.* HORRIBILIS).

Catalogue number.	Locality.	Sex.	Length.	Width.	Remarks.
3837	Sacramento, Cal	.....	15.60	9.05	Very old.
1218	Monterey, Cal	.....	15.75	.....	Do.
7401	.....do	.....	14.05	7.75	
3630	.....do	.....	16.00	8.50	Very old.
6905	.....do	♂	15.40	8.10	Do.
3538	Fort Tejon, Cal	♀	13.25	7.45	
3537	.....do	♂	14.75	8.90	
3536	.....do	♀	14.50	9.20	
2066	Los Nogales, Sonora	.....	14.40	8.00	Var. "*horricæus*" Baird.
990	Copperminea, N. Mex	♂	14.50	8.25	Do.
3818	Medicine Bow Mountains (eastern slope)	.....	14.75	8.50	
13245	Big Porcupine Creek, Mont	♀	13.25	7.40	
14785	Nebraska	.....	13.45	6.90	
7146	Franklin Bay, Arctic Sea	♂	12.35	7.30	"Barren Ground Bear."
6551	.....do	.....	13.40	8.65	Do.
6548	.....do	.....	12.45	7.25	Do.
4441	Russia	.....	13.75	7.53	

The question of the relationship of the large Bears of North America to those of the Old World has long been a vexed one, and is, of course, one not easily settled. In the present collection are thirty-three skulls, representing various ages, but the greater part are adult. These include two only from the Old World, six from the Arctic coast, eleven from California, and fourteen from various localities in the Rocky Mountains, from Idaho Territory to Arizona.

Among the American specimens are two rather easily distinguishable forms, one of which is the large Grizzly, or *U. horribilis* of authors, from the western parts of the United States; the other, the smaller so-called Barren Ground Bear of Arctic America; both being undoubtedly specifically distinct from the *Ursus americanus*. The Barren Ground form* differs from the more southern Grizzly not only in its smaller size, but in its strong tendency to a depression of the frontal region of the skull, where the simple flattening of this region in the Grizzly is here often carried so far as to form a well-marked concavity as in the true *arctos* of the Old World. Sometimes, however, *U. horribilis* also presents a considerable depression between the postorbital processes, as great even as in average specimens of *U. arctos*, as is the case in No. 7401 from Monterey, Cal. The Barren Ground Bear's skull generally presents a more dog-like aspect, in consequence of the thickening superiorly of the postorbital border of the frontals, than is seen in *U. horribilis*, it approaching in this respect to the form seen in *Ursus spelæus*, where this feature attains its highest development, resulting in the very strong frontal depression so characteristic of the skulls of that species.

The dentition of *U. arctos*, *U. richardsoni*,† and *U. horribilis* presents no important differences, the chief difference being the relatively rather smaller size of the teeth in the latter. The form of the last upper molar is almost precisely the same in the two first named, and the differences presented by *U. horribilis* are both slight and inconstant. In *U. richardsoni*, this tooth narrows gradually, and about equally, on each side posteriorly, almost exactly as in *U. arctos*, it being widest at or near its extreme anterior border. While this is sometimes the case in *U. horribilis*, its greatest breadth is generally one-fifth the length of the tooth behind the anterior border, and the tooth is relatively broader posteriorly

* Named by Captain Mayne Reid, in one of his stories, "*Ursus Richardsoni*"!

† The Barren Ground Bear skulls in the collection are labeled with this name.

than in the others. Specimens of *U. horribilis*, from the same locality, however, differ more among themselves in this respect than the average difference between *U. horribilis* and *U. arctos*. The teeth, however, in *U. arctos* are relatively larger than in *U. horribilis*, the difference being quite appreciable. The teeth of the Franklin Bay specimens (*U. richardsoni*), on the other hand, are of the same relative size as in the Old World examples of *U. arctos*.

After a careful consideration of the subject, I believe the Barren Ground Bear of Richardson (*U. richardsoni* of Mayne Reid) to be not even subspecifically distinct from the true *U. arctos* of the Old World. The Grizzly, from its larger size, widely different geographical distribution, apparently larger claws, slight differences in the dentition and in the form of the frontal region of the skull, may be so regarded (*U. arctos* subsp. *horribilis*), as it can hardly be doubted that it gradually passes into the Barren Ground form.

The subjoined table of detailed measurements of the skulls of *U. arctos horribilis* indicates the wide range of individual variation that may be looked for among skulls from the same locality. These variations not only affect the ratio of width to length, through the greater or less elongation of the facial portions of the skull as compared to the rest, but also all the other proportions are more or less variable, including even the teeth themselves. Thus, two specimens from California, of practically the same length (15.60 and 15.40), vary in breadth from 8.10 to 9.05, while two others vary still more, one, with a breadth of 9.20, having a length of only 14.50, while another, with a breadth of 8.50, has a length of 16.00! In these last, the ratio of width to length varies from 0.53 to 0.63. In two California specimens of practically the same length (15.60 and 15.75), the length of the last molar varies from 1.43 to 1.58. In the series of California specimens alone, the length of the last molar varies from 1.35 to 1.66, and the width of the same from 0.67 to 0.80, the widest tooth being, furthermore, *not* the longest. As already stated, the last upper molar attains its greatest width near the anterior border, but in several specimens the width of the anterior third is nowhere greater than the width of the tooth at its middle; and the same is also sometimes true in *U. richardsoni*.

14785	.....	"Nebraska"		....	13.45	12.80	6.90	2.57	3.73	3.90	1.35	2.50	8.08	6.90	2.57	2.87	1.60	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	7.25	4.07	1.73	Middle-aged.
4441	.....	Russia		....	13.75	13.20	7.53	2.78	4.20	3.50	1.33	2.83	2.98	6.85	2.97	3.00	1.80	9.40	3.75	3.08	5.62	7.50	4.62	1.47	Do.
7146	.....	Franklin Bay, Arctic Sea	♂	....	12.35	11.85	7.30	2.88	4.00	3.32	1.16	2.80	2.60	6.25	2.70	2.78	1.82	8.43	3.65	2.20	4.53	6.25	4.23	1.40	Rather young.
6551	.....	do		....	13.40	12.70	8.65	3.08	4.50	3.40	1.38	3.05	2.80	6.70	3.08	2.90	2.25	9.25	4.12	2.90	4.87	6.65	3.90	1.33	Middle-aged.
6548	.....	do		....	12.45	.....	7.25	2.75	4.05	3.30	1.20	2.55	2.72	6.05	2.55	2.72	1.82	8.20	3.60	2.63	4.65	6.42	3.93	1.37	Do.

Measurements of the molar teeth of URSUS ARCTOS *et var.*

Catalogue number.	Locality.	Sex.	Upper first molar.		Upper second molar.		Upper third molar.		Remarks.
			Length.	Width.	Length.	Width.	Length.	Width.	
13245	Big Porcupine Creek, Mont.	.....	0.60	0.52	0.91	0.63	1.40	0.65	Subsp. *horribilis.*
3318	Medicine Bow Mountains, Wash.	.....	0.57	0.48	0.74	0.60	1.36	0.67	Do.
990	Copper Mines, N. Mex	.....	0.60	0.54	0.92	0.70	1.35	0.70	Do.
7401	Monterey, Cal	.....	0.67	0.52	0.91	0.65	1.50	0.74	Do.
3630	.....do	.....	0.72	0.65	0.97	0.75	1.66	0.75	Do.
6905	.....do	.....	0.67	0.53	0.93	0.64	1.56	0.80	Do.
3537	Fort Tejon, Cal	.....	0.65	0.50	0.93	0.69	1.52	0.75	Do.
3536	.....do	.....	0.65	0.51	0.93	0.67	1.43	0.72	Do.
3538	.....do	.....	0.55	0.45	0.87	0.66	1.35	0.67	Do.
6557	Arctic coast	.....	0.66	0.51	0.95	0.70	1.37	0.70	"*richardsoni.*"
6548	.....do	.....	0.57	0.45	0.88	0.64	1.41	0.68	Do.
7146	.....do	.....	0.62	0.48	0.92	0.65	1.40	0.71	Do.
4441	Russia	.....	0.68	0.57	0.94	0.72	1.40	0.75	*arctos.*
1033	Northern Sweden	.....	0.63	0.40	0.90	0.65	1.27	0.67	Do.

URSUS AMERICANUS.

Seventeen skulls of this species, embracing all the aged ones in the collection, seem to indicate a slight increase in size to the southward. Four aged skulls from Louisiana and Florida range in length from 12.50 to 13.10, and three others, more or less immature, would doubtless have attained an equal size had they lived to be as old. A Georgia specimen, also not full-grown, has a length of 11.15, and in old age would probably have considerably exceeded 12.00. The other specimens, all full-grown and some of them very old, range from 9.90 to 12.15, most of them falling between 10.25 and 11.75. The largest (12.15) is from Puget Sound. A New York specimen comes next in size (11.90); New Mexican specimens next, the Alaskan being the smallest. This certainly points to a southward increase in size; but a much larger series would, of course, be necessary in order to establish positively whether the increase is in this direction. It would seem natural to expect it to be so, since the Bear is a hibernating animal, and is active for a much shorter period in northern than in southern localities.

It seems worthy of remark that only a small proportion of the skulls of Bears, and even of other *Carnivora*, including the Minks, Otters, and Martens, seen in collections, are specimens of mature age. The proportion of fully adult and very aged specimens is much greater among those from the unsettled parts of the continent than among those from the older States, owing, doubtless, to these animals being so closely hunted in the more settled districts that they rarely live to a very great age.

Measurements of seventeen skulls of URSUS AMERICANUS.

Catalogue-number.	Locality.	Sex.	Length.	Width.	Remarks.
3834	Key Biscayne, Fla	....	13.10	.....	Very old.
1155	Prairie Mer Rouge, La	....	12.90	7.40	Do.
1156	.....do	....	12.70	7.45	Do.
987	.....do	....	12.50	7.35	Do.
1154	.....do	....	11.10	6.10	Middle-aged.
988	.....do	....	10.60	5.95	Rather young.
3894	Georgia	....	11.15	6.10	Middle-aged.
3798	New York	....	11.80	7.35	
2250	.....do	....	11.00	7.55	
994	Copper Mines, N. Mex	....	9.90	6.07	Very old; brown.
992	.....do	....	11.35	7.05	Do.
991	.....do	....	11.75	6.85	Very old; black.
12398	Henry's Lake, Wyo	♂	11.40	7.40	
3650	Puget Sound	....	12.15	7.40	
6949	.....do	....	10.20	6.00	
8695	Alaska	....	10.25	6.30	
9477	.....do	....	10.07	5.15	

The range of variation not dependent upon locality is more fully indicated in the table of detailed measurements of these skulls given below, but certain of the most prominent points of variation are not well shown by any series of measurements. Especially is this the case in respect to the amount of convexity different specimens present, in which individual variation is strongly marked. One of the most prominent distinctions of *U. americanus* as compared with *U. arctos* and its varieties is the great convexity of the upper outline of the skull, both antero-posteriorly and transversely. Another feature is the constriction of the facial portion, giving a concave outline to the nasals when viewed in profile. But there are exceptions, even to the first of these distinctions, one or two specimens occurring (especially No. 2250 from New York) in which the flattening of the frontal region is as marked as in average skulls of *U. horribilis*. This flattening is also well marked in Nos. 1155 and 1156, from Louisiana. The greatest convexity is reached in No. 3484, from Key Biscayne, Fla.; this and No. 2250 (New York) presenting the two extremes in respect to convexity. No. 3894, from Georgia, has about the same degree of convexity as the Florida specimen. No. 2250 is also remarkable for the shortness of the facial portion of the skull, thereby imparting to it a greater than the usual ratio of width to length. In this specimen (mentioned by Professor Baird as remarkable for its width*), the width is 0.69 of the length. In another, from Louisiana (No. 1155), it falls as low as 0.54! The average ratio of width to length is about 0.56 to 0.60.

The teeth of *U. americanus* seem, in looking at them, to be relatively much smaller than in *U. arctos*, but, upon careful measurement, the difference is quite small, while they are of the same relative size as those of *U. horribilis*. In *U. americanus*, the temporal ridges pass more abruptly inward toward the medial line of the skull than in either *U. horribilis* or *U. arctos*.

The most important distinction presented by *U. americanus* is the form of the last upper molar. In *U. americanus*, the crown is widest at the middle, narrowing both anteriorly and posteriorly, but most rapidly posteriorly. The inner border is nearly straight; the outer has a prominent medial convexity, while in *U. horribilis* and *U. arctos* both outlines are nearly straight and generally about equally convergent. In *U. americanus*, the anterior third of the last molar is generally narrower

*Mam. N. Amer., p. 227.

than the middle third, though sometimes equaling it; but it is never wider, as it almost invariably is in *U. horribilis* and *U. arctos*. The Puget Sound specimens have the anterior third the narrowest; in Alaskan specimens, it reaches its extreme width, while New York and Louisiana examples present the medium phase.

The skulls of *U. cinnamomeus* do not seem to be in any way distinguishable from average skulls of *U. americanus*, the distinction between them being one of color only and inconstant as characterizing any particular locality or region.

The upper molar teeth of *U. americanus*, as shown by the subjoined measurements, differ considerably in size in fully adult specimens. The first molars range in length of crown from 0.40 to 0.52, and in the width of the same from 0.27 to 0.42. The second ranges in length from 0.67 to 0.78; the third from 0.94 to 1.22, and in width from 0.51 to 0.67! In two specimens, with the first 0.44 in length, the third in one has a length of only 0.94 and the other 1.07! In another, the length of the first molar is 0.41 and the third 1.11. In still another, with the length of the first molar 0.43, the length of the third is 0.96. In two others, while the length of the first molar is 0.50 in each, the third molar in one has a length of 1.22 and in the other 1.15.

The largest skulls of *U. americanus* nearly equal in size the smaller skulls of *U. arctos horribilis*, and actually overlap the series from Franklin Bay and the measurements given by authors of the true *arctos* of the Old World. In view of this fact, and of the great range of individual variation in size, cranial and dental characters, and the unreliability of color as a specific character, I too hastily, in former papers,* referred all the American land-bears, including the *U. americanus*, to the *U. arctos*, which I am now convinced was a mistake; *U. americanus* being, I now believe, unquestionably specifically distinct, and the Grizzly subspecifically separable from the *U. arctos* of the Old World.

* Bulletin Mus. Comp. Zoöl., vol. i, pp. 184-192, Oct., 1869; Bulletin Essex Institute, vol. vi, pp. 46, 54, 59, 63, 1874.

Measurements of seventeen skulls of URSUS AMERICANUS.

Catalogue-number.	Locality.	Sex.	Total length.	Anterior end of intermaxillaries to occipital condyles.	Greatest width.	Distance between orbits.	Expanse of postorbital processes.	Nasal bones, length.	Nasal bones, width before.	Least width of muzzle behind the canines.	Upper incisors, from front to molars.	Upper incisors, from front to hinder margin of palate.	Distance between external edges of canines.	Upper molars, length taken together.	Upper molars, distance between.	Lower jaw, length.	Lower jaw, height.	Anterior end of intermaxillaries to anterior end of nasals.	Anterior end of intermaxillaries to the orbit.	Anterior end of intermaxillaries to postorbital processes.	Anterior end of nasals to postorbital processes.	Length of crown of last molar.	Remarks.
3650	Puget Sound	....	12.15	11.35	7.40	2.80	4.00	3.00	1.10	2.32	2.85	5.82	2.53	2.14	1.64	8.03	3.18	2.55	4.52	6.15	3.80	1.08	Very old.
6949	do	....	10.20	9.80	6.00	2.48	3.45	2.54	1.12	2.18	2.35	4.93	2.15	2.07	1.35	7.10	2.74	2.22	3.75	5.32	3.25	1.00	Do.
8695	Alaska	....	.....	9.75	6.30	2.50	3.60	2.70	1.10	2.08	2.43	5.30	2.15	2.00	1.25	7.15	3.03	2.07	4.00	5.50	3.47	0.98	Do.
9477	do	....	10.07	9.25	5.15	2.33	3.07	2.40	0.90	1.95	2.33	4.85	1.95	2.00	1.37	6.57	2.50	1.98	3.68	5.00	3.10	0.93	
3798	New York	....	11.80	11.10	7.35	2.57	3.80	3.13	1.15	2.35	2.74	5.53	2.63	2.22	1.55	7.50	3.30	2.60	4.35	6.00	3.70	1.00	
2250	do	....	11.00	10.50	7.55	2.77	4.12	2.55	1.18	2.25	2.50	5.33	2.43	1.85	1.75	7.50	3.33	2.12	3.78	5.34	3.35	0.90	
3484	Key Biscayne, Fla	....	13.10	11.75	.....	2.70	4.25	.....	1.20	2.53	2.75	5.85	2.62	2.22	1.72	8.60	4.03	2.80	4.57	6.35	3.85	1.06	
1155	Prairie Mer Rouge, La	....	12.90	12.10	7.40	2.65	3.80	2.55	1.02	2.68	2.57	6.20	2.78	2.48	1.66	8.80	3.73	2.70	4.57	6.20	3.50	1.21	
1156	do	....	12.70	11.60	7.45	2.65	4.00	2.90	1.19	2.37	2.50	5.85	2.70	2.38	1.78	8.05	3.75	2.80	4.30	5.90	3.35	1.18	
987	do	....	12.50	11.75	7.35	2.85	3.80	3.12	1.03	2.50	2.70	6.10	2.65	2.36	1.62	8.25	3.70	2.30	4.45	6.20	4.00	1.15	
1154	do	....	11.10	10.30	6.10	2.44	3.35	2.83	1.10	2.06	2.30	5.30	2.07	2.00	1.35	7.05	3.15	2.07	3.90	5.45	3.50	0.96	Middle-aged.
988	do	....	10.60	10.15	5.95	2.32	3.25	2.73	1.00	2.23	2.25	5.45	2.20	2.25	1.57	7.20	3.05	2.03	3.62	5.20	3.27	1.11	Rather young.
3894	Georgia	....	11.15	10.50	6.10	2.35	3.27	2.80	0.95	2.03	2.46	5.60	2.10	2.20	1.35	7.30	3.15	2.20	4.05	5.62	3.50	1.08	Middle-aged.
994	Copper Mines, N. Mex	....	9.90	9.20	6.07	2.25	3.30	2.80	1.12	1.95	2.30	5.00	2.10	2.03	1.55	6.75	2.73	2.00	3.60	5.25	3.40	1.03	Very old; brown.
992	do	....	11.35	10.60	7.05	2.45	3.60	2.92	1.08	2.20	2.55	5.60	2.57	2.07	1.54	7.75	3.00	2.50	4.26	6.00	3.50	1.02	Do.
991	do	....	11.75	10.60	6.85	2.56	3.70	2.87	1.12	2.30	2.40	5.75	2.56	2.05	1.56	7.75	3.35	2.30	4.00	5.65	3.65	1.07	Very old; black.
12398	Henry's Lake, Wyo	♂	11.40	10.60	7.40	2.55	3.82	2.75	1.12	2.35	2.60	5.70	2.45	2.00	1.70	7.80	3.35	2.30	3.95	5.50	3.35	0.95	

RSUS AMERICANUS.

	Upper first molar.		Upper second molar.		Upper third molar.	
	Length.	Width.	Length.	Width.	Length.	Width.
.....	0.50	0.42	0.78	0.60	1.22	0.64
.....	0.52	0.35	0.75	0.54	1.17	0.6[illegible]
.....	0.50	0.33	0.76	0.54	1.15	0.64
.....	0.45	0.38	0.72	0.48	1.00	0.5[illegible]
.....	0.44	0.37	0.67	0.46	0.94	0.5[illegible]
.....	0.42	0.33	0.69	0.47	1.00	0.5[illegible]
.....	0.50	0.39	0.76	0.55	1.18	0.6[illegible]
.....	0.50	0.38	0.76	0.58	1.15	0.6[illegible]
.....	0.43	0.35	0.70	0.52	0.96	0.5[illegible]
.....	0.41	0.35	0.75	0.57	1.11	0.6[illegible]
.....	0.40	0.32	0.71	0.51	1.08	0.5[illegible]
.....	0.44	0.33	0.68	0.50	1.07	0.5[illegible]
.....	0.43	0.32	0.70	0.50	1.03	0.5[illegible]

RY.

	Length.	Width.	Remarks
Average ..	10.38	5.40	
....do	9.45	5.07	
....do	9.69	5.18	
....do	8.37	4.31	
Maximum .	11.50	6.20	
....do	10.50	5.50	
....do	10.15	5.50	
....do	8.75	4.62	
Minimum .	9.20	4.50	
....do	8.75	4.50	
....do	9.35	4.85	
....do	7.75	4.05	
Average ..	7.23	3.61	
....do	7.25	3.65	
....do	7.69	3.75	
Maximum.	7.60	3.80	
....do	7.95	4.00	
....do	7.60	3.80	
Minimum .	6.65	3.38	
....do	6.95	3.50	
....do	7.45	3.48	
Average ..	5.98	3.20	Var. *fulvus.*
....do	5.80	3.02	Do.
....do	5.78	2.90	"*macrurus.*"
....do	5.40	2.80	Var. *fulvus.*
....do	5.58	3.08	Var. *alopex.*
Maximum	6.20	3.32	Var. *fulvus.*
...do	6.10	3.28	Do.
....do	6.00	3.20	"*macrurus.*"
....do	5.68	2.95	Var. *fulvus.*
....do	5.70	3.15	Var. *alopex.*
Minimum .	5.70	2.90	Var. *fulvus.*
....do	5.55	2.87	Do.
....do	5.40	2.78	"*macrurus.*"
....do	5.20	2.70	Var. *fulvus.*
....do	5.50	3.04	Var. *alopex.*
Average ..	4.97	2.64	Var. *virginianus.*
....do	4.56	2.64	Do.
....do	4.56	2.54	Do.
....do	4.20	2.32	Do.
....do	3.80	2.03	Var. *littoralis.*
.....	3.75	1.98	Var. *virginianus.*
Maximum	4.70	2.70	Do.
....do	4.60	2.70	Do.

TABULAR SUMMARY—Continued.

Species.	Locality.	Number of specimens.	Sex.		Length.	Width.	Remarks.
Urocyon virginianus.	Southern California	3	....	Maximum.	4.63	2.65	Var. *virginianus.*
Do	Tehuantepec, Mexico	3	....	....do	4.40	2.37	Do.
Do	Islands off California	3	....	....do	3.85	2.23	Var. *littoralis.*
Do	Pennsylvania, Washington, and Virginia.	3	....	Minimum.	4.62	2.56	Var. *virginianus.*
Do	Texas	2	....	....do	4.50	2.58	Do.
Do	Southern California	3	....	....do	4.50	2.43	Do.
Do	Tehuantepec, Mexico	3	....	....do	4.15	2.25	Do.
Do	Islands off California	3	....	....do	3.75	2.05	Var. *littoralis.*
Felis concolor	New York and Oregon	3	....	Average	7.57	5.15	
Do	Texas and Louisiana	3	....	....do	8.72	5.48	
Do	New York and Oregon	3	....	Maximum.	7.80	5.25	
Do	Texas and Louisiana	3	....	....do	8.75	5.60	
Do	New York and Oregon	3	....	Minimum.	7.40	5.05	
Do	Texas and Louisiana	3	....	....do	8.40	5.35	
Felis pardalis	Matamoras, Mexico	5	....	Average	4.98	3.33	
Do	Costa Rica	4	....	....do	5.89	3.86	
Do	Southern Mexico and Central America.	8	....	....do	5.78	3.74	Includes the Costa Rican series.
Do	Matamoras, Mexico	5	....	Maximum	5.25	3.50	
Do	Costa Rica	4	....	....do	6.20	4.19	
Do	Southern Mexico and Central America.	8	....	....do	6.20	4.19	
Do	Matamoras, Mex	5	....	Minimum.	4.50	3.05	
Do	Costa Rica	4	....	....do	5.35	3.60	Includes the Costa Rican series.
Do	Southern Mexico and Central America.	8	....	....do	5.35	3.60	
Lynx rufus	British North America	9	....	Average	5.01	3.52	"*canadensis.*"
Do	Washington and Oregon Territories.	7	....	....do	5.03	3.56	"*fasciatus.*"
Do	Texas and Matamoras, Mex	8	....	....do	5.00	3.40	"*maculatus.*"
Do	United States (mainly Ft. Tejon, Cal.)	10	....	....do	4.91	3.47	"*rufus.*"
Do	British North America	9	....	Maximum	5.30	3.70	"*canadensis.*"
Do	Washington and Oregon Territories.	7	....	....do	5.50	3.95	"*fasciatus.*"
Do	Texas and Matamoras, Mex	8	....	....do	5.27	3.72	"*maculatus.*"
Do	United States (mainly Ft. Tejon, Cal.)	10	....	....do	5.50	3.82	"*rufus.*"
Procyon lotor	New York, Pennsylvania, and Georgia.	15	....	Average	4.27	2.91	
Do	Southern Texas and California.	6	....	....do	4.57	3.11	
Do	Southern Mexico and Costa Rica.	9	....	....do	4.60	3.15	
Do	New York, Pennsylvania, and Georgia.	15	....	Maximum.	4.57	3.03	
Do	Southern Texas and California.	6	....	....do	4.78	3.38	
Do	Southern Mexico and Costa Rica.	9	....	....do	4.85	3.42	
Putorius vison	Alaska (chiefly)	18	♂♀	Average	2.68	1.58	
Do	New York	13	♂♀	....do	2.40	1.34	
Do	Alaska (chiefly)	12	♂	....do	2.81	1.63	
Do	do	6	♀	....do	2.48	1.46	
Do	do	12	♂♀	Maximum.	3.02	1.90	Male.
Do	New York	6	♂♀	....do	2.60	1.48	Do.
Do	Alaska (chiefly)	2	♂♀	Minimum.	2.30	1.40	Female.
Do	New York	4	♂♀	....do	2.17	1.18	Do.
Mustela americana	Peel River	4	♂	Average	3.39	2.07	
Do	Yukon River	9	♂	....do	3.34	1.98	
Do	Fort Good Hope	5	♂	....do	3.24	1.95	
Do	Lake Superior	10	♂	....do	3.14	1.76	
Do	Umbagog Lake, Maine	8	♂	....do	2.96	1.72	
Do	Northern New York	5	♂	....do	3.02	1.61	
Do	Peel River	4	♂	Maximum.	3.50	2.12	
Do	Yukon River	9	♂	....do	3.55	2.15	
Do	Fort Good Hope	5	♂	....do	3.37	2.05	
Do	Lake Superior	10	♂	....do	3.23	1.89	
Do	Umbagog Lake	8	♂	....do	3.10	1.85	
Do	Northern New York	5	♂	....do	3.10	1.68	
Do	Peel River	4	♂	Minimum.	3.35	2.02	
Do	Yukon River	9	♂	....do	3.00	1.73	
Do	Fort Good Hope	5	♂	....do	3.15	1.73	
Do	Lake Superior	10	♂	....do	3.02	1.65	

TABULAR SUMMARY—Continued.

Species.	Locality.	Number of specimens.	Sex.		Length.	Width.	Remarks.
Mustela americana	Umbagog Lake	8	♂	Minimum	2.73	1.50	
Do	Northern New York	5	♂	do	2.92	1.50	
Taxidea americana	Northern localities	5		Average	5.00	3.18	
Do	Southern localities	5		do	4.62	2.92	
Do	Northern localities	5		Maximum	5.22	3.50	
Do	Southern localities	5		do	4.75	3.07	
Do	Northern localities	5		Minimum	4.92	2.97	
Do	Southern localities	5		do	4.50	2.80	
Lutra canadensis	Newfoundland and Umbagog Lake, Maine.	10		Average	4.24	2.79	
Do	Southern localities	4		do	4.37	2.86	
Do	Newfoundland and Umbagog Lake, Maine.	10		Maximum	4.50	3.00	
Do	Southern localities	4		do	4.50	2.95	
Do	Newfoundland and Umbagog Lake, Maine.	10		Minimum	3.96	2.53	
Do	Southern localities	4		do	4.22	2.75	
Mephitis mephitica	Western localities	10		Average	3.10	1.95	
Do	New England	10		do	2.88	1.72	
Do	Southern localities	5		do	2.73	.....	
Do	Western localities	10		Maximum	3.50	2.25	
Do	New England	10		do	3.25	1.85	
Do	Southern localities	5		do	2.90	.....	
Do	Western localities	10		Minimum	2.85	1.70	
Do	New England	10		do	2.70	1.53	
Do	Southern localities	5		do	2.60	.....	
Ursus arctos	California	8		Average	14.81	8.42	Subsp. *horribilis*.
Do	Rocky Mountains	5		do	12.07	7.81	Do.
Do	Arctic coast	3		do	12.77	7.73	Subsp. *arctos*.
Do	California	8		Maximum	16.00	9.20	Subsp. *horribilis*.
Do	Rocky Mountains	5		do	14.75	8.50	Do.
Do	Arctic coast	3		do	13.40	8.65	Subsp. *arctos*.
Do	California	8		Minimum	13.25	7.45	Subsp. *horribilis*.
Do	Rocky Mountains	5		do	13.25	6.90	Do.
Do	Arctic coast	3		do	12.45	7.25	Subsp. *arctos*.
Ursus americanus	Georgia, Florida, and Louisiana.	7		Average	12.01	6.72	
Do	New York	2		do	11.40	7.45	
Do	New Mexico	3		do	11.00	6.66	
Do	Puget Sound and Alaska	4		do	10.67	6.21	
Do	Georgia, Florida, and Louisiana.	7		Maximum	13.10	7.40	
Do	New York	2		do	11.80	7.55	
Do	New Mexico	3		do	11.75	7.05	
Do	Puget Sound and Alaska	4		do	12.15	7.40	
Do	Georgia, Florida, and Louisiana.	7		Minimum	10.60	5.95	
Do	New Mexico	3		do	9.90	6.07	
Do	Puget Sound and Alaska	4		do	10.07	5.15	

SEXUAL, INDIVIDUAL, AND GEOGRAPHICAL VARIATION IN LEUCOSTICTE TEPHROCOTIS.

By J. A. Allen.

Some months since, my attention was called by Capt. Charles Bendire, U. S. A., to the fact of the existence of a well-marked difference in color between the sexes of two varieties of *Leucosticte tephrocotis*, namely, *littoralis* and *tephrocotis*. Under date of January 28, 1876, Captain Bendire wrote me, "There is a good deal of difference between the sexes of both varieties; so much that they can in almost every case be separated before dissection. The brown on the breasts of the females is much duller than that of the males." This statement, he added, was based on a series of seventy specimens of variety *littoralis* and on a series of about a dozen specimens of variety *tephrocotis*. Under date of April 18, Captain Bendire wrote me further on the subject, he in the mean time having sent me two lots of specimens, about two dozen examples in all, which seemed to fully confirm his statements. In the later account, in speaking of a series of eighty-five specimens of variety *littoralis*, of which the sex of each had been determined by careful dissection, he says there was not a single female in the whole lot that was as bright as the palest-tinted males. He says further, "I have examined over two hundred skins of variety *littoralis* and about thirty of variety *tephrocotis*. I find a constant difference, and have never yet obtained a female which I could not readily distinguish from a male before skinning; but, nevertheless, every specimen was dissected, and the sex not guessed at." With this letter was forwarded to me by Captain Bendire a series of thirteen skins of variety *littoralis* and three of variety *tephrocotis*, which were selected impartially by himself and Lieut. George R. Bacon, to show the extreme ranges of variation in color in the two sexes of each variety. The series of variety *littoralis* was taken from a lot of eighty-two skins, and is stated to embrace two of the brightest females and several of the dullest males of the whole lot. Separating the series by color, without reference to the labels, I found, on looking at the labels, that I had placed all the females in one series and all the males in the other. In the case of only one specimen was there any reason for hesitancy in making the separation; but this even, I found on reference to the label, I had placed in its proper series. The general aspect of the two series I found was quite different, noticeably so at a considerable distance, through the much paler tints of the females. "Several of the skins", adds Captain Bendire, "are poorly prepared; but they will answer every purpose for description, and I repeat my statement *that they represent the brightest females and dullest males of the whole lot.*" Lieutenant Bacon, who assisted in making the selection, says (writing at the same time) that the series sent to me was made up with great care, so as to show the dullest and brightest of each sex. "I have prepared", Lieutenant Bacon adds, "some eighty skins of variety *littoralis*, and have found no difficulty in distinguishing the sexes before skinning. I have not

found one female as bright as the dullest male. It is my opinion that the same remarks apply to variety *tephrocotis*."

The above statements of Captain Bendire and Lieutenant Bacon are made in reference to some very positive remarks by Mr. Robert Ridgway, in his recent very elaborate monograph of the genus *Leucosticte*, in respect to sexual variation among the different forms of this group. Mr. Ridgway says, "The American species of this genus fall into two distinct groups, according as the sexes do or do not differ in appearance. In *L. tephrocotis*, in all its forms, there is not the slightest sexual difference; but, in *L. atrata* and *L. australis*, the distinction is very marked."* Under the head of *L. tephrocotis* var. *littoralis*, Mr. Ridgway further says, "In regard to the two sexes, as compared to one another, there is *the same absolute similarity in appearance and size*† that exists in *griseinucha* and *tephrocotis*, *many females*† being more brightly colored and some larger than some males. The apparently larger average of the dimensions of the [*seven*] female[s] indicated in the above measurements is no doubt due to the small number of specimens of the sex examined."‡

Mr. Ridgway's tables seem to indicate that the sex was known in only a small proportion of his specimens, namely, in fourteen (seven males and seven females) out of forty-eight in variety *littoralis*, and in about one-third in variety *tephrocotis*. As already stated, Captain Bendire's specimens, in which the sex was carefully determined by dissection, show a very considerable constant sexual difference in coloration, and, as will be presently shown, also in size.

Through some unfortunate inadvertence, an important error has crept into Mr. Ridgway's table of comparative measurements given on page 60 (*l. c.*); the measurements of the two sexes of *L. tephrocotis* being given as, male, wing, 4.21; tail, 3.12; female, wing, 4.16; tail, 3.12; thus apparently sustaining Mr. Ridgway's generalization in respect to the absence of difference in size in the two sexes of this form. In examining Captain Bendire's specimens, however, I was struck with the apparently smaller size of the females; and, on referring to the measurements recorded on his labels, this apparent difference proved to be real. I then turned to Mr. Ridgway's table of the measurements of *L. tephrocotis*, and, carefully computing the averages given by Mr. Ridgway, I met with quite different results, the thirty-four females giving an average length of wing of 4.05, and of tail of 2.97, against the 4.16 and 3.12 given by Mr. Ridgway, and of course giving a considerably smaller average than for the males, namely, 4.05 against 4.21 for the wing, and 2.97 against 3.12 for the tail.

The averages given in the same connection by Mr. Ridgway for the two sexes of *L. littoralis* (seven males and seven females) are borne out by the table of measurements on which they are based, and seem to indicate that there is no sexual variation in size in this form. Through the kindness of Captain Bendire, I have before me measurements (sent to me by my special request) of forty-two males and twenty-six females of *L. littoralis*, in which the wing averages respectively 4.23 for the males and 4.05 for the females. In addition to these, seven males and six females, which he had previously sent me, gave 4.19 for the length of the wing in the male and 4.02 for the same in the female; thus showing that not only in coloration but also in size there is a well-marked sexual variation in this form as well as in *tephrocotis*, about the

* "Monograph of the genus *Leucosticte*," etc., Bull. U. S. Geolog. and Geograph. Survey of the Territories, No. 2, second series, p. 60, May, 1875.

† Not italicized in the original.

‡ Loc. cit., p. 75.

same, in fact, as occurs in *L. australis*, in which and in *L. atrata* Mr. Ridgway admits it to be well marked.

L. griseinucha is the only other American form of *Leucosticte* alleged by Mr. Ridgway to show no sexual difference in size or color.

In respect to individual variation, Mr. Ridgway remarks as follows: "There is no noticeable range of individual variation among typical examples of any form, and it is only the *transitional specimens connecting two races of one species that vary at all from the normal standard*",* etc. (*l. c.*, p. 60). "Regarding the subject of individual variation, we shall say little, since the immense series at our command shows that this is really insignificant" (*l. c.*, p. 58). These remarks are made in reference to statements of mine quoted by Mr. Ridgway, in which I say that "it *seems probable* that some of the differences whereon certain species† of *Leucosticte* have been founded may be only individual variations". This remark had reference to a series of mounted specimens in the Museum of the Boston Society of Natural History, collected at Central City, Colo., by Mr. F. E. Everett. My remarks respecting these Mr. Ridgway also quotes (*l. c.*, p. 55), and, without having seen them, in commenting on them in foot-notes, assigns them, with great positiveness, to his different species and varieties of *Leucosticte*. In point of fact, there is a considerable range of color-variation in birds of the same sex from the same localities, referable, unquestionably, to the same varieties. These affect not only the intensity of the general tints, but the areas of dusky and ashy markings about the head, as Mr. Ridgway's own comments under *L. littoralis* sufficiently show. Whether or not such specimens form the intergrading links between varieties is immaterial to the point at issue.

In respect to individual variation in size, it is sufficient to say that the length of the wing varies in males of variety *littoralis* from 3.90 to 4.50, and in the females from 3.88 to 4.25; in variety *tephrocotis* (see Mr. Ridgway's tables), from 4.00 to 4.40 in the males, and from 3.90 to 4.30 in the females; in variety *griseinucha*, from 4.25 to 4.75 in the males, and from 3.90 to 4.80 in the females! It seems *a priori* improbable that such a wide range of individual variation in size should obtain without there being also considerable variability in color. Such a state of things would certainly be an exceptional and noteworthy fact in our present knowledge of individual variation among birds.

As the present forms a convenient opportunity for noticing some other strictures by Mr. Ridgway on some general remarks of mine respecting this group, I will add a few words respecting geographical variation among the different forms of *Leucosticte*. Mr. Ridgway, in commenting on my attempt "to show a correlation between the distinguishing characters of the different forms of this genus and the recognized general laws of geographical variation", in which I claim the northern forms to be larger, with more ash on the head, etc., says that, respecting these statements, "there is need of correction. *There is no such variation from the north southward as that stated in the passage quoted, for the northern forms are quite as brightly colored as the most southern ones*,‡ while in the gray-headed races of *L. tephrocotis* it is the more southern one (var. *littoralis*) which has the most gray. Thus, in this latter race the throat is more or less gray, frequently entirely gray; while, in var. *griseinucha*, the whole throat is black. Var. *griseinucha* is also much

* Not italicized in the original.

† Referring, among others, to *L. campestris*, a form Mr. Ridgway himself does not regard as even *varietally* distinguishable.

‡ Not italicized in the original.

brighter-colored than its southern ally, the red being not only deeper and more extended, but the brown of the body is darker and richer! ..... The fact that *littoralis* has more gray on the head than *tephrocotis* cannot be explained by stating that the former is more northern in its distribution, for such is not the case, since the breeding grounds of var. *tephrocotis* are quite as far northward in the interior as those of var. *littoralis* is on the coast. We must, therefore, look to some other explanations of these variations than the laws of climatic modifications which are now recognized. The single instance of apparent correspondence to a general rule of geographical variation is seen in *L. griseinucha* of the Alaskan coast, which is more northern in its habitat than *L. littoralis* of the more southern North-Pacific coast, and is also larger in size."—(*Loc. cit.*, pp. 58, 59.)

From much of the above I must beg leave to dissent, as matters of fact. In the first place, *L. australis* was one of the forms to which I especially referred, and which, because it has since been considered by him as a species rather than a variety, Mr. Ridgway leaves wholly out of consideration in this connection. It is, however, one of the "forms of *Leucosticte*" to be considered, and is also the most *southern*, the *smallest*, and by far the *brightest-colored*.* Climatologically considered, *L. tephrocotis* is the *next most southern*,† is the *next in size* (at least is not *larger* than variety *littoralis*), *and has the least ash* on the head. The breeding-range of *L. littoralis is not known*, and this form *has not yet been taken* on the "southern part of the North-Pacific *coast*", unless Alaska can be so considered. In size, it does not appreciably differ from *L. tephrocotis*. It probably passes the summer *in the interior*, to the westward of the breeding-range of *L. tephrocotis*, and hence under rather more northern climatic conditions. *L. griseinucha* is the *most northern* and much the *largest*. Its darker colors are *easily explainable* on climatic grounds, or by "the laws of climatic modification which are now recognized". Its darker colors simply correlate with those of the generality of the varietal forms of Birds and Mammals inhabiting the same region, remarkable for its immense annual rain-fall and great humidity of

*L. "*atrata*" I have purposely omitted in this consideration. If, however, it is anything more than a melanotic phase of variety *tephrocotis*, it finds in that form a very near ally, and if entitled to specific, or even varietal, recognition, gives further proof of the generalization here proposed, it being much darker and smaller than *tephrocotis*. Mr. Ridgway says of *atrata*, "the pattern of coloration is precisely similar to that of *L. tephrocotis*, but the totally different tints (black or dusky-slate, instead of chocolate-brown), *and the very marked difference between the sexes*,* separate it at once as a distinct species. It may be suggested that it is a melanism of *tephrocotis;* but, if this were so, there would be no such entire uniformity of characters as is exhibited throughout the series of five specimens, while in *tephrocotis* there *is not the slightest sexual difference in colors*."* It will be noticed from the above that one of the strong points relied upon by Mr. Ridgway as distinguishing *atrata* from *tephrocotis* is the supposed absence of sexual variation in *tephrocotis*, and its presence in *atrata*, a distinction founded on error.

†In this view I find I am sustained by Mr. C. E. Aiken, who says, "From these facts, and information derived from other sources, I infer that the gray-cheeked variety (*littoralis*) is the most northern race, and that many of them do not find their way so far south [as Cañon City, Colo.] except in severe winters. In this belief I am strengthened by the fact that, of sixty birds killed in Wyoming in 1870, all but one or two were typical *tephrocotis;* that *tephrocotis* occupies, during the breeding season a more southern locality than the preceding [*littoralis*], and winters, regularly, in the Rocky Mountains of Colorado, and even farther south; that *australis* inhabits the next lower section, breeding in Colorado, and probably extending into the British possessions, but wintering, for the most part—especially in severe winters—south of this Territory; that *atrata*, if anywhere common, must occupy a more southern locality."—(Quoted from Mr. Ridgway's Mon., *l. c.*, pp. 62, 63.)

*Not italicized in the original.

climate;* a fact that Mr. Ridgway seems for the moment to have forgotten.

As a further contribution to the history of *Leucosticte tephrocotis*, I append the measurements of seventy-seven specimens of varieties *littoralis* and *tephrocotis*, kindly sent me by Captain Bendire. As the measurements were made by the collector from fresh specimens, and as the sex of each specimen was determined by actual dissection, they are of special interest in the present connection.

Measurements of LEUCOSTICTE TEPHROCOTIS *var.* LITTORALIS.

Locality.	Date.	Sex.	Length.	Wing.	Tail.	Collected by—
Camp Harney, Oreg		♂	6.75	4.00	2.70	Capt. Charles Bendire.
Do		♂	7.00	4.32	3.00	Do.
Do		♂	6.65	4.00	2.70	Do.
Do		♂	7.00	4.21	2.90	Do.
Do		♂	7.00	4.25	2.75	Do.
Do		♂	6.90	4.25	3.00	Do.
Do		♂	7.00	4.30	3.00	Do.
Do		♂	7.00	4.37	3.05	Do.
Do		♂	7.00	4.00	3.00	Do.
Do		♂	7.00	4.25	2.90	Do.
Do		♂	7.00	4.25	3.00	Do.
Do		♂	6.95	4.20	2.88	Do.
Do		♂	6.60	4.15	2.90	Do.
Do		♂	6.75	4.00	2.90	Do.
Do		♂	6.65	4.00	2.95	Do.
Do		♂	6.50	4.00	2.75	Do.
Do		♂	6.90	4.25	3.00	Do.
Do		♂	6.50	3.90	2.75	Do.
Do		♂	7.00	4.40	2.90	Do.
Do	Mar. 1	♂	7.12	4.25	3.12	Do.
Do	Feb. 26	♂	7.00	4.37	2.94	Do.
Do	Feb. 26	♂	6.94	4.23	2.87	Do.
Do	Jan. 26	♂	6.60	4.00	2.75	Lieut. George R. Bacon.
Do	Jan. 6	♂	6.80	4.00	2.65	Do.
Do	Jan. 20	♂	7.25	4.25	3.00	Do.
Do	Jan. 6	♂	6.87	4.25	3.00	Capt. Charles Bendire.
Do		♂	6.75	4.20	2.75	Do.
Do		♂	7.00	4.30	2.80	Do.
Do		♂	6.93	4.32	2.96	Lieut. George R. Bacon.
Do		♂	7.00	4.45	2.94	Do.
Do		♂	7.00	4.32	2.98	Do.
Do		♂	7.00	4.42	2.90	Do.
Do		♂	7.00	4.25	2.90	Do.
Do		♂	6.45	4.50	2.95	Do.
Do		♂	6.80	4.25	2.75	Do.
Do		♂	7.00	4.13	2.94	Do.
Do		♂	6.80	4.35	2.95	Do.
Do		♂	7.03	4.31	2.93	Do.
Do		♂	6.95	4.32	3.00	Do.
Do		♂	6.30	4.05	2.68	Do.
Do		♂	6.75	4.27	2.70	Do.
Do		♂	6.98	4.35	2.95	Do.
Do		♂	6.94	4.18	2.75	Do.
Do		♂	7.05	4.37	2.87	Do.
Do		♂	6.75	4.32	2.75	Do.
Do		♂	7.05	4.32	2.96	Do.
Do		♂	6.75	4.25	2.90	Do.
Do		♂	6.75	4.25	2.95	Do.
Do		♂	7.00	4.13	2.80	Do.
Do		♀	6.75	4.00	2.65	Capt. Charles Bendire.
Do		♀	6.50	4.12	2.90	Do.
Do		♀	6.60	4.00	2.50	Do.
Do		♀	6.75	4.00	2.75	Do.
Do		♀	6.50	4.00	2.75	Do.
Do		♀	6.70	4.00	2.75	Do.
Do		♀	6.68	4.00	2.80	Do.
Do		♀	6.70	4.00	2.90	Do.
Do		♀	6.60	3.95	2.75	Do.
Do		♀	6.68	3.88	2.78	Do.
Do		♀	6.95	4.12	3.00	Do.
Do	Mar. 1	♀	6.65	4.00	2.75	Lieut. George R. Bacon.
Do	Jan. 6	♀	6.75	4.13	2.75	Capt. Charles Bendire.
Do	Feb. 26	♀	6.75	4.02	2.65	Do.

* See Bull. Mus. Comp. Zoölogy, vol. ii, pp. 237, 239, April, 1871; Proc. Bost. Soc. Nat. Hist., vol. xvi, pp. 279–284, June, 1874.

Measurements of LEUCOSTICTE TEPHROCOTIS var LITTORALIS—Continued.

Locality.	Date.	Sex.	Length.	Wing.	Tail.	Collected by—
Camp Harney, Oreg	Jan. 26	♀	6.70	4.00	2.85	Lieut. George R. Bacon.
Do	Mar. 1	♀	6.75	4.05	2.88	Do.
Do	Mar. 1	♀	6.50	3.92	2.50	Capt. Charles Bendire.
Do		♀	6.65	4.00	2.65	Lieut. George R. Bacon.
Do		♀	6.50	4.12	2.90	Do.
Do		♀	6.60	4.00	2.50	Do.
Do		♀	6.75	4.00	2.75	Do.
Do		♀	6.50	4.00	2.75	Do.
Do		♀	6.70	4.00	2.75	Do.
Do		♀	6.68	4.00	2.80	Do.
Do		♀	6.70	4.00	2.90	Do.
Do		♀	6.60	3.95	2.75	Do.
Do		♀	6.68	3.88	2.78	Do.
Do		♀	6.95	4.12	3.00	Do.
Average of 49 males			6.82	4.22	2.89	
Average of 28 females			6.67	4.01	2.76	

Measurements of LEUCOSTICTE TEPHROCOTIS *var.* TEPHROCOTIS.

Locality.	Sex.	Length.	Wing.	Tail.	Collected by—
Camp Harney, Oreg	♂	6.85	4.25	2.85	Lieut. George R. Bacon.
Do	♂	6.85	4.25	2.85	Do.
Do	♂	6.50	4.12	2.75	Do.
Do	♂	6.75	4.12	2.60	Do.
Do	♂	6.85	4.45	2.95	Capt. Charles Bendire.
Do	♂	6.80	4.08	2.62	Do.
Do	♂	6.75	4.20	2.70	Do.
Do	♂	6.80	4.25	2.78	Do.
Do	♂	6.50	4.25	2.75	Do.
Do	♂	7.18	4.39	3.00	Do.
Do	♂	6.80	4.30	2.75	Do.
Do	♀	6.75	4.00	2.62	Lieut. George R. Bacon.
Do	♀	6.85	4.25	2.90	Do.
Do	♀	6.50	4.00	2.50	Capt. Charles Bendire.
Do	♀	6.60	4.15	2.70	Do.
Do	♀	6.25	4.00	2.50	Do.
Do	♀	6.70	4.16	2.75	Do.
Average of 11 males		6.79	4.24	2.78	
Average of 6 females		6.61	4.09	2.66	

DESCRIPTIONS AND ILLUSTRATIONS OF FOSSILS FROM VANCOUVER'S AND SUCIA ISLANDS, AND OTHER NORTHWESTERN LOCALITIES.

By F. B. Meek, *Palæontologist.*

The fossils described and illustrated in this paper were in part collected by Mr. George Gibbs, geologist of the Northwestern Boundary Survey, under the direction of Archibald Campbell, esq., the commissioner appointed in behalf of the United States Government on the joint commission for the survey of the Northwestern Boundary-line.

Most of the Cretaceous species from Vancouver's Island, however, had been some time previously sent on to the Smithsonian Institution, and briefly described, without illustrations, in a paper published by the writer in the Transactions of the Albany Institute (vol. iv, 1856), for the first time announcing the discovery of Cretaceous rocks at that distant northwestern locality. On the return of the Boundary commission in 1861, the additional collections of fossils obtained during that survey were submitted to the writer for study, and preliminary descriptions of those believed to be new were published in the Proceedings of the Philadelphia Academy of Natural Sciences for that year. Soon after, the following more extended descriptions, and the accompanying plates of drawings of these fossils, were prepared for publication in Mr. Campbell's report, in connection with that of Mr. Gibbs, on the geology of the country along the line of the boundary. None of the elaborate geological or natural history results, however, of this survey were published in Mr. Campbell's report; and consequently none of the descriptions and drawings, as presented in this paper, were ever issued. In the mean time, figures of four or five of the Cretaceous species have been published (mainly without descriptions) in the reports of the geological survey of California; but the other species have not hitherto been illustrated, nor any of them described with much detail.

As it has, therefore, been considered very desirable that full descriptions of all of these species, with figures of the same, from the original typical specimens, should be published, permission was obtained through Mr. Gibbs, the geologist of the survey, to publish this paper through whatever agency might be found most convenient.

All of the fossils under consideration, with possibly the exception of one Tertiary species, it will be seen, belong to the Carboniferous and Cretaceous systems. Those of Carboniferous age come from the eastern slope of the second principal range of the Rocky Mountains, near a small stream known as Katlahwoke Creek, latitude 49° north, and longitude 114° west from Greenwich; this being the highest northern point, it is believed, at which rocks of this age have yet been identified by organic remains along the Rocky Mountain range. They are contained in a hard gray and bluish-gray limestone, breaking with a rough, irregular fracture, and sometimes presenting an obscurely subcrystalline structure. These limestones, according to the observations of Mr. Gibbs,

crop out along the slope of the mountain, while reddish and yellowish ripple-marked sandstones compose the upper part of the same. Below the limestone, he saw exposures of a whitish fine sandstone, hand specimens of which closely resemble examples of the Potsdam sandstone brought by Dr. Hayden from the Black Hills and several localities along the Rocky Mountains, where that rock is known to be immediately overlaid by Carboniferous limestones.

Fossils are apparently rare in this Carboniferous limestone, near the line of the boundary survey, where they are usually so firmly imbedded in the hard brittle matrix that no specimens were procured in a condition to show very clearly their specific characters. Those collected consist of a small *Zaphrentis*, a *Spirifer* allied to *S. Keokuk*, a small *Athyris* apparently undistinguishable from *A. subtilita*, and a large *Productus* agreeing nearly with *P. latissimus*, Sowerby.

From these fossils, we can safely refer this rock to the Carboniferous system, and even with some degree of confidence, to the lower or Mountain Limestone series of the same. It is true, *Athyris subtilita* is generally, in this country, regarded as a Coal-Measure species; but we have a form in the Lower Carboniferous series of the Mississippi Valley. scarcely distinguishable, which is even by some regarded as a variety of *A. subtilita*; while Mr. Davidson identifies that species in the Lower Carboniferous rocks of England. *Spirifer Keokuk* and *Productus latissimus* are both Lower Carboniferous species, while the latter is very unlike any of our known American Coal-Measure species. In its lithological characters, the matrix containing these fossils likewise agrees well with beds in the region of the Great Salt Lake containing Lower Carboniferous fossils, and apparently the same *Spirifer* mentioned above; while it is quite unlike any of the known beds of the Far-West that can be certainly referred to the Coal-Measures.

The presence here of Carboniferous rocks would seem to lend at least some encouragement to the hope that true coal of Carboniferous age may be found at some place along the Rocky Mountains farther south, near the line of the North Pacific Railroad.

A few fragments of apparently Carboniferous or possibly Devonian fossils were also found on a small tributary of Fraser River, about fifty miles from the Gulf of Georgia. They occur in a dark, very hard, partly metamorphosed limestone, and consist of crinoid columns, and a portion of a large *Zaphrentis*. The crinoid columns have been dissolved out, and the cavities subsequently filled with calcareous matter retaining the original form, but not the structure of the fossils. Some of the columns measure as much as 0.80 inch in diameter, and show by the constrictions in the comparatively large central cavity some fourteen or fifteen segments in the space of an inch. The *Zaphrentis*, when entire, must have measured about 2½ inches in diameter at the larger end, being nearly as large as the Devonian *Z. gigantea*, though proportionally shorter, more abruptly tapering, and apparently more curved. None of these specimens, however, were in a condition to be figured.

The Cretaceous fossils contained in the collection are from two localities on Vancouver's Island, and in part from Sucia Islands in the Gulf of Georgia. Those originally sent to the Smithsonian Institution were all from Vancouver's Island, and at the time they were examined by the writer, were supposed to have been all obtained from one locality, though we now know that they came from two distinct localities. They gave evidence, in the nature of the matrix, however, as well as in the species, of having been obtained from two different beds or rocks, one of which was unhesitatingly referred to the Cretaceous epoch. The specimens

from the other bed at Nanaimo being, so far as determined, all new species, and belonging apparently to genera common to the Cretaceous and Jurassic systems, some doubts were entertained whether or not they might belong to the latter; though it was stated that from their general characters and affinities, it appeared more probable that they belonged also to the Cretaceous. On looking them over some time after, however, the writer was led to suspect that they might be of Jurassic age, which suggestion was mentioned to Dr. Newberry, who referred to it in his report on the geology of Captain Williamson's Pacific Railroad Survey.

A review of the whole subject, however, with the aid of the additional light derived from the more extensive collections brought in by the Northwestern Boundary Survey, fully confirmed the original conclusion that the whole belong to the Cretaceous. One of the strongest evidences of this is the occurrence, in these beds at Nanaimo, of numerous dicotyledonous leaves,of so modern an aspect that some who have examined these leaves alone, without regard to the associated molluscan remains, have even thought that these beds ought to be referred to the Tertiary.* That they do not belong to the Tertiary, however, is evident from the fact that they also contain a large species of *Inoceramus* and a *Goniomya*, together with Cretaceous types of *Trigonia* and *Pholadomya*.

The Nanaimo locality is on the eastern shore of Vancouver's Island, and Komooks, or Komax,† which is also on the eastern shore of the same, is about sixty to seventy miles farther northwest; while the Sucia Islands are in the Gulf of Georgia, about the same distance in a southeast direction from Nanaimo. At the Nanaimo locality, the beds consist of sandstone, good coal, and conglomerates, composed of small pebbles, with seams of greenish-gray and brownish beds of arenaceous matter containing fossils, the whole dipping eastward. The same beds also occur on the neighboring Douglass and New Castle Islands, where they likewise contain coal. These beds seem to be quite distinct from those at Komooks and on Sucia Islands, both in their fossils and in their lithological characters; and from the affinities of their fossils, as as well as from the direction of the dip of the strata, I am inclined to believe them older than those seen on the Suica Islands and at Komooks, though the whole seems to belong to division A of the California reports. The Nanaimo beds do not seem to be equivalent to any of the subdivisions recognized in the Upper Missouri country.

The Komooks and Sucia Island beds, however, appear, both from the affinities of their fossils, and from the state of preservation of the latter, to be related to what we have called the "Fort Pierre group", or division No. 4 of the Upper Missouri section. In the latter district, this division is composed mainly of dark plastic and indurated clays, in which the fossils often occur enveloped in hard concretions, and show the substance of the shells in a beautiful state of preservation. Those from Komooks and Sucia Islands are in a similar state of preservation, and appear to have been enveloped in similar concretions; while the specimens from Nanaimo are mainly casts, or, where they retain any portion of the shell, it is more decomposed and has an older look. Among the species from Komooks and Sucia Islands, some of the Baculites and a *Nautilus* are related to species found in No. 4 of the Upper Missouri, while one of the *Ammonites* and one of *Inoceramus* appear scarcely to differ more than as varieties from forms found in the horizon mentioned in the Upper Missouri.

* These plant-remains have been investigated by Dr. Newberry, and by him referred to the Cretaceous.

† Mr. Gabb writes this name "Komax" in the California report.

These Sucia and Komooks beds are also almost certainly representatives of those of the New Jersey Greensand series, containing *Ammonites complexus*, *Placenticeras placenta*, *Nautilus Dekayi*, *Baculites ovatus*, *Gryphæa vesicularis*, *Inoceramus Barabini*, &c., as well as of the Upper Chalk of Europe.

SMITHSONIAN INSTITUTION, *Washington City*, *June*, 1871.

CARBONIFEROUS SPECIES.

BRACHIOPODA.

Genus PRODUCTUS, Sowerby.

PRODUCTUS LATISSIMUS, Sowerby.

Plate 1, fig. 1.

Productus latissimus, Sowerby (1822), Mineral Conch., pl. 330.—Phillips (1836), Geol. Yorks., ii, pl. viii, fig. 1.—DeKoninck (1847), Monogr Chonetes et Prod., pl. ii, fig. 2; and pl. iii, fig. 2.—Davidson (1861), Scottish Carb. Brach., pl. ii, figs. 8, 9; and (1857), Monogr. British Carb. Brach., 145, pl. xxv, figs. 1–4.

Shell attaining a large size, thin, rather depressed, much wider than long, with a subsemicircular outline; anterior margin not produced; hinge-line long, straight, but apparently not quite equaling the greatest breadth. Ventral valve moderately convex or arched, with a regularly-increasing curve from the front to the beak; anterior margin not produced and presenting a more or less nearly semicircular outline; beak incurved, but not prominent; lateral extremities slightly rounded; ears more or less arched, and not in any way defined from the convexity of the central region, which is nearly or quite without a mesial sinus; scars of divaricator muscles distinct and subquadrate; surface without concentric wrinkles, and marked by moderately distinct, rounded, rather small, radiating costæ, or coarse striæ, that generally increase by intercalation, and number about four or five in the space of 0.20 inch, near the front. Dorsal valve unknown.

Length, 1.67 inches; breadth, about 2.53 inches; convexity, 0.71 inch.

Although I have seen only very imperfectly-preserved specimens of this shell, they agree so nearly in almost all of their known characters with *P. latissimus* of Sowerby that I can scarcely doubt their identity with that species, which has not, I believe, before been even provisionally identified from any American locality. None of our specimens show the little short spines seen on the ventral valve of Sowerby's species, but they are all more or less worn, while some slight remains of what appear to be the bases of a few of these spines are seen on some of the specimens.

At first I was rather inclined to think this shell might belong to the closely-allied *P. giganteus* of Martin; but the fact that well-preserved internal casts of the ventral valve show no traces of the cavities for the reception of the internal spiral arms, such as occur in *P. giganteus*, favors the conclusion that it more probably belongs to *P. latissimus*. It also agrees with the latter, and differs from the former, in having its ears passing gradually into the convex part of the shell without any depressions to mark the limits between these parts. This latter character, and the lateral extension of the ears, however, are better seen in

some specimens in the collection too imperfect to be figured, than in the one from which the figure given on plate 1 was drawn.

Locality and position.—Carboniferous limestone, at Katlahwoke Creek, just west of the principal range of the Rocky Mountains, latitude 49° north, longitude 114° west.

Genus SPIRIFER, Sowerby.

SPIRIFER KEOKUK, Hall?

Plate 1, figs. 3, 3, *a*.

Spirifer Keokuk, Hall (1858), Geol. Report Iowa, i, 642, pl. xx, figs. 3, *a–d*, and 2 *d*.
Spirifer Keokuk, var., *ib.*, 676, pl. xxiv, figs. 4, *a*, *b*, *c*, *d*.

The specimens of this *Spirifer* in the collection are very imperfect; but as far as their characters can be made out, they present no peculiarities by which they can be distinguished from the shell described by Professor Hall under the name *S. Keokuk*. Colonel Simpson, Mr. King, and Dr. Hayden have also brought, from dark-bluish and gray limestones at various localities in Utah and other far western districts, specimens of apparently the same shell. There is also in the Coal-Measures of the Western States a *Spirifer* that has been described by Professor Hall under the name *S. opimus*, in his Iowa Report (and, as I think, more recently by Professor McChesney, under the name *S. subventricosus*), that seems to be very closely allied.

Locality and position.—Gray Carboniferous limestone; Kootenay range of Rocky Mountains.

Genus ATHYRIS, McCoy, 1844, = SPIRIGERA, d'Orbigny, 1847.

ATHYRIS SUBTILITA, Hall (sp.).

Plate 1, figs. 2, 2 *a*.

Terebratula Roysii, d'Orbigny (1842), Voy. dans l'Amér. Mérid., viii, 44, pl. iii, figs. 17–19; (not L'Eveillé (sp.), 1835).
Terebratula subtilita, Hall (1852), in Stansbury's Report Exp. to Great Salt Lake, 409, pl. iv (by error pl. ii), figs. 1, *a*, *b*, and 2, *a*, *b*.—Schiel (1855), Report Pacific R. R. Survey, ii, 108, pl. 1, figs. 2, *a*, *b*.—Davidson? (1856), Brit. Carb. Brach., 18, pl. 1, figs. 21 and 22.—Hall (1856), Report Pacific R. R., iii, 101, pl. ii, figs. 1 and 2.—Marcou (1858), Geol. N. Am., 52, pl. vi, fig. 9, *a*, *b*, *c*, *d*, *e*, *f*.
Athyris subtila, Davidson (1856), British Carb. Brach., 86, pl. i, figs. 21 and 22, and pl. xvii, figs. 8–10.—Salter (1861), Qr. Jour. Geol. Soc. Lond., 64, pl. iv, fig. 4.

As nearly as can be determined from a single specimen of the shell under consideration, it appears to agree well with *A. subtilita* in form and general appearance. It is smaller, however, than the usual adult size of that species; but, like other species of the genus, that shell is known to vary considerably in size at different localities.

In the Mississippi Valley, *A. subtilita* is usually regarded as being confined to the Coal-Measures and Permo-Carboniferous beds; but the British examples cited above came from the Lower Carboniferous. We have in our Lower Carboniferous (Chester group) a form described, by Professor Hall in the Iowa Report, under the name *A. subquadrata*, which

so nearly resembles it that some consider the latter as only a variety of *A. subtilita.*

Locality and position.—Katlahwoke Creek, just west of the second principal range of the Rocky Mountains; latitude 49° north, longitude 114° west; Carboniferous.

CRETACEOUS SPECIES.

LAMELLIBRANCHIATA.

Genus NUCULA, Lamarck.

NUCULA TRASKANA, Meek.

Nucula Traskana Meek (1857), Trans. Albany Inst., iv, 39.

Shell trigonal-ovate, with both extremities rather narrowly rounded: cardinal border sloping from the beaks at an angle of about one hundred degrees; base forming a broad gentle curve; beaks nearly central, rather elevated; surface unknown; muscular impressions shallow; hinge having in each valve about fifteen teeth on each side of the small pit for the reception of the ligament.

Length, 0.27 inch; height, 0.18 inch; breadth, 0.16 inch.

The only specimen of this species that I have seen is a cast, which is so much worn as to show imperfectly the surface-characters. As nearly as can be determined, it appears to have been provided with rather distinct concentric lines of growth; and, judging from a depression along the anterior slope of the cardinal margin, it was probably provided with a well-defined lunule. The species will probably be recognized by its ventricose trigonal-ovate form, and nearly central beaks.

Since first describing this species, the only specimen in the collection has been mislaid, so that I am unable to give a figure of it. The specific name was given in honor of Dr. John B. Trask, of San Francisco.

Locality and position.—The specimen came with others labeled "Nanaimo, Vancouver's Island"; though it may have been collected at Komooks.

Genus GRAMMATODON, Meek.

GRAMMATODON? VANCOUVERENSIS, Meek.

Plate 3, figs. 5 and 5 *a*.

Arca Vancouverensis, Meek (1857), Trans. Albany Institute, iv, 40.

Shell small, longitudinally oblong, moderately gibbous, comparatively thick and strong; anterior margin rounding up from below and meeting the end of the hinge nearly at right angles; posterior side somewhat obliquely truncated; base nearly straight and parallel with the hinge: cardinal area rather narrow; hinge nearly or quite equaling the greatest length of the shell; beaks located a little in advance of the middle, rather small, and incurved; posterior umbonal slopes prominently rounded from the beaks to the postero-basal margin; surface orna-

mented by small linear radiating costæ, which are crossed by fine concentric striæ and stronger marks of growth. Near the anterior end of the shell, the radiating costæ are a little larger and much more widely separated than farther back.

Length, 0.75 inch; height, 0.47 inch; breadth or convexity, 0.40 inch.

I am not well enough acquainted with the hinge of this little shell to be quite sure that it is congeneric with the form on which I proposed to found the genus *Grammatodon* in the Palæontology of the Upper Missouri. One of the casts shows a little of the impression of the hinge in front of the beaks, with apparently four or five small teeth, or denticles, ranging obliquely forward and upward. The posterior muscular impression, as seen in this cast, shows no traces whatever of the lamina connected with that of the posterior adductor, such as exists in *Cucullæa*.

Locality and position.—Komooks, Vancouver's Island; cretaceous.

Genus? ARCA, Linn.

ARCA? EQUILATERALIS, Meek.

Plate 2, figs. 6 and 6 *a*.

Arca (Cucullæa?) equilateralis, Meek (1857), Trans. Albany Institute, iv, 40.

Internal cast of medium size, equilateral, transversely oblong-oval in form, gibbous in the central and umbonal regions; anal margin obliquely truncated; anterior side subtruncated; base nearly straight along the middle, and rounding up abruptly at the extremities; dorsal outline sloping from the beaks; hinge less than the length of the valves, and parallel to the base; cardinal area comparatively small; beaks central, moderately elevated, and rather gibbous, but somewhat flattened on the outside, and incurved at right angles to the hinge; muscular impressions shallow. Surface (of cast) retaining faint traces of small radiating costæ, or striæ.

Length, 1.68 inches; height, 1.02 inches; breadth or convexity, 0.80 inch.

This species will be readily distinguished from any other with which I am acquainted, resembling it in other respects, by the central position of its beaks. None of the specimens show the hinge, or surface-markings, though faint traces of radiating lines, or striæ, seen on the internal casts, show that it was probably marked by small radiating costæ. It is not easy to decide from the specimens in the collection whether it is an *Arca* or a *Cucullæa*, or, indeed, with certainty, whether it belongs even to the *Arcidæ*. There is on the cast a shallow, obscure depression near each posterior muscular scar; but these depressions seem not so distinct as those always seen on casts of *Cucullæa*, while none of the specimens show the hinge, though there appears to be a small cardinal area.

Locality and position.—Nanaimo?, Vancouver's Island; Cretaceous.

[illegible], Sowerby.

[illegible]. SUBUNDATUS.

[illegible] 3, 3 *a*.

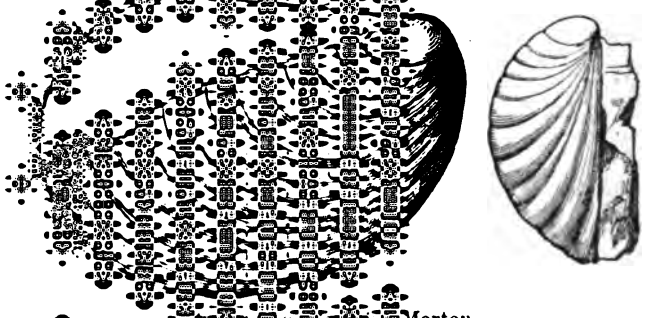
[illegible]wns, or Illust. Geol. Sussex, 133, pl. [illegible] figs. 4, *a*, *b*.—Zittel (1864), Bivalves [illegible] 2 (varieties and synon. ?).
[illegible] is Org. Rem., 62, pl. 13, fig. 11.
[illegible]. Sci. Philad., xiii, 315.

[illegible] subcircular, rather gibbous; [illegible] more or less regularly into the [illegible] ree-fourths of a circle; hinge [illegible] the entire length of the shell; [illegible] rior margin, and rising but [illegible] mented by regular concentric [illegible] of nearly uniform size, and [illegible]

[illegible]s; convexity of right valve, [illegible]

[illegible] disposition to make of shells [illegible] more or less nearly like this [illegible] Mantell, though it has always [illegible] distinct from Mantell's type. [illegible] seen Mantell's original speci- [illegible] figure and very brief descrip- [illegible] exact specific limits.

[illegible] ame to retain for these shells [illegible] at Dr. Morton in this country [illegible] *i*, that is also generally con- [illegible] however, included two forms [illegible] pecies. One of these is repre- [illegible] drawn from Morton's original



[illegible] Morton.

[illegible] orton's type specimen.

[illegible] he other form, represented by [illegible] n's specimen, represents the [illegible] ect. The latter agrees more [illegible] ve have the means of com- [illegible] seems at least not very clearly

Professor Tuomey concluded that Morton's types represented two distinct species, and named the more elongated form represented by the annexed cut *I. gibbus*, regarding the other as the true *I. Barabini*. At one time, I was inclined to think that this arrangement might be admissible in case Morton had included two types, and that they were both good species. A more attentive reading of Morton's description, however, seems to me to show that he rather regarded the elongated or more oval form as the typical one, not only because he *first* refers to it in connection with the name *I. Barabini*, but because he describes that species as "obliquely-oval", which would not be applicable to the rounder form represented by figures 2 and 2 *a* of our plate 3. That the Vancouver shell under consideration may be identical with the latter, I am inclined to believe; but still the question remains an open one whether either can be properly regarded as *I. Cripsii*.

In originally studying the form under consideration, I proposed to call it *I. subundatus*; but, after seeing how widely *I. Cripsii* is supposed to vary by European authorities, I have concluded to refer our shell to it as a variety *subundatus*. Figure 3 of our plate 3 represents a specimen of somewhat different outline; still I think it belongs to the same species as figure 1 of the same plate.

Locality and position.—Sucia Islands; Cretaceous.

INOCERAMUS ——?

Plate 1, fig. 6.

This is also a rather compressed left valve of an ovoid or subcircular shell, with a straight hinge, apparently about equaling half its entire length. It may possibly belong to the same species as the two forms already described, though it possesses stronger and more irregular as well as sharper concentric folds, and has a more obtuse beak, with a more regularly-rounded posterior margin. As it came from a different locality, however, and was found associated with an entirely different group of fossils, the probability is it belongs to a distinct species. Still the specimen is too imperfect to be positively identified with any known species, or described with any degree of confidence as new.

I was at first inclined to think either this shell or the last might possibly be the more compressed valve of *Inoceramus Vancouverensis*, Shumard; but on examining more carefully his description in the Transactions of the Saint Louis Academy, I find the specimen described by him is also a left valve, and has a very gibbous, elevated beak. This being the case, none of the forms in the collection before me can, I think, be properly referred to that species.

Locality and position.—Nanaimo, Vancouver's Island; Cretaceous.

Genus TRIGONIA, Bruguière.

TRIGONIA EVANSI, Meek.

Plate 2, figs. 7, 7 *a*, 7 *b*.

Trigonia Evansi, Meek (1857), Trans. Albany Inst., iv, 42.—Gabb (1864), California Geological Report, i, 189, pl. 25, fig. 17.

Shell arcuate-subtrigonal, gibbous anteriorly, contracted, cuneate, and slightly gaping behind; ventral margin deeply rounded in outline in the middle; anterior side very short, rounding up nearly vertically

to the beaks; posterior extremity quite narrowly rounded, or subtruncated; dorsal margin very concave in outline, and sharply carinate or erect along its whole length; escutcheon lance-oval, being widest anteriorly, where it is distinctly concave on each side of the carina formed by the erect dorsal margins of the valves, bordered along each side by a low ridge commencing very narrow at the beaks and widening gradually posteriorly, with a well-defined narrow mesial sulcus along the entire length of each of these ridges; concave space within these ridges ornamented by small, nearly smooth, transverse costæ, extending up to the dorsal margin; beaks nearly terminal, rather narrow, erect, and strongly incurved at nearly right angles to the longitudinal axis of the valves. Surface ornamented by from eighteen to about twenty-two angular transverse costæ that terminate abruptly above, along the low ridge bounding the escutcheon; costæ sometimes slightly crenated, particularly those on the more gibbous anterior region; lines of growth moderately distinct. Internal cast showing only obscure traces of the costæ; posterior muscular impression deep; pallial line moderately distinct.

Length, 2.65 inches; height, about 1.86 inches; convexity, 1.70 inches.

In its general outline as well as in the nature of its costæ, this shell resembles *T. limbata*, d'Orbigny (Paléont. Fr. Terr. Crét., iii, pl. 298). It may be readily distinguished, however, not only by its less prominently-rounded anterior ventral region and more erect and more anterior beaks, but by its more arcuate dorsal outline, and especially by having along each side of its escutcheon a depressed, longitudinally-sulcated ridge, upon which the costæ do not pass. In the latter character, it agrees more nearly with *T. crenulata*, Lamarck, and *T. aliformis*, Parkinson; but it differs from these species too decidedly in form and the nature of its costæ to require detailed comparisons.

It is almost certainly the same shell that was referred by Mr. Etheridge among Mr. Hector's collections from Nanaimo, to *T. Emoryi*, Conrad (pl. iii, fig. 2, *a*, *b*, *c*, United States and Mexican Boundary Survey Report). It is, however, certainly very distinct from that species, not only in form and in its decidedly less crenate costæ, but more particularly in having a smooth, longitudinally sulcate, depressed ridge along each side of its escutcheon, not crossed by the costæ. Its costæ are likewise less numerous and more prominent.

Locality and position.—Cretaceous beds at Nanaimo, Vancouver's Island.

Mr. Gabb states, in the California report, that it is common in division A of the survey of that State, at Tuscan Springs, Tehama County; Chico Creek, Butte County; Curry's, south of Mount Diablo; Benicia; Martiñez; Rancho de San Luis Gonzaga, Pacheco's Pass; Jacksonville and Siskiyou Mountains, Oregon. Mr. William P. Blake also presented to the Smithsonian Institution some masses of rock from Crooked River, Oregon, containing beautiful, sharply-defined moulds of this species.

Genus PROTOCARDIA, Beyrich.

PROTOCARDIA SCITULA Meek.

Plate 3, figs. 4 and 4 *a*.

Cardium scitulum, Meek (1857), Trans. Albany Institute, iv, 40.

Shell very small, circular or subquadrate, gibbous; anterior margin rounded; posterior side subtruncated; base slightly rounded; beaks nearly central, gibbous, incurved, and moderately elevated; surface

marked by exceedingly fine, obscure, closely-arranged, concentric striæ, which are crossed on the posterior umbonal slopes by a few stronger radiating lines, extending from near the beaks to the posterior and postero-basal margins. Hinge and interior unknown.

Length and height, 0.15 inch; breadth or convexity, 0.12 inch.

This delicate little shell resembles *Cardium subquadratum* of Evans and Shumard, but is much more gibbous, and more rounded in outline, than specimens of that species of its own size. It also differs in having much more distinct radiating lines on its posterior side; those on *Cardium subquadratum* being almost entirely obsolete. In the roundness of its outline, as well as in the gibbous character of its valves, it approaches *Cardium rarum* of Evans and Shumard; still, its posterior margin is more truncated, and its radiating lines much more distinct. It likewise differs from both of these species in being a much smaller shell than either of them; though it may be the young of even a larger species.

Mr. Gabb has described two Cretaceous species of this group in the California Geological Reports, under the names *Protocardia Placerensis* and *P. translucida*, that may, one or both, be related to this, though they differ in outline.

Locality and position.—Komooks, Vancouver's Island; Cretaceous.

Genus CYPRIMERIA, Conrad.

CYPRIMERIA? TENUIS, Meek.

Plate 2, figs. 5, 5 *a*, and 5 *b*.

Dosinia? tenuis, Meek (1861), Proceed. Acad. Nat. Sci. Philad., xiii, 315.

Shell circular or slightly oval, extremely thin, and much compressed; lateral and basal margins regularly rounded, very thin, and sharp; beaks small, compressed, central, projecting little above the dorsal margin; lunule small and rather deep; surface marked by fine concentric striæ.

Length and height each 1.26 inches; convexity about 0.22 inch.

I have merely placed this species provisionally in the genus *Cyprimeria*, not having seen specimens showing either the hinge or other internal characters. It has much the appearance of a *Lucina*, but some of the internal casts appear to show that its anterior muscular impressions are not as in that genus, while they also give indications of a double oblique tooth just in front of the beaks, more nearly as we see in *Cyprimeria*.* It is a rather common species, and will be readily identified by its circular compressed form and extreme thinness. It is closely allied, so far as regards general appearance, to *Artemis lenticularis* of Forbes from the Cretaceous at Pondicherry, Southern India (Trans. Geol. Soc. Lond., vol. vii, pl. 18, fig. 7).

Locality and position.—At several places near Nanaimo, Vancouver's Island, and on New Castle Island; Cretaceous.

* In the cast represented by figs. 5 *a* and 5 *b*, the tooth does not show its double character so clearly as others.

Genus PHOLADOMYA, Sowerby.

PHOLADOMYA SUBELONGATA, Meek.

Plate 2, figs. 1 and 1 *a*.

Pholadomya subelongata, Meek (1857), Trans. Albany Institute, iv, 42.

Shell transversely oblong-oval, rather elongated and depressed; valves gibbous, particularly in the umbonal region; anterior side very short and abruptly rounded; posterior side rounded or subtruncated, and more or less gaping; basal margin forming a broad semi-elliptical curve, sometimes nearly straight along the middle; dorsal margin concave in outline, so as to be nearly parallel with the base; false area rather well defined just behind the beaks, but becoming obsolete a little further back; beaks nearly terminal, depressed, and incurved. Surface of each valve ornamented by from sixteen to twenty-five small radiating costæ, most of which pass from the beaks obliquely backward and downward to the postero-basal margin, those near the anterior end being much more distant than the others, and separated by spaces from four to six times their own breadth. Small concentric wrinkles mark the surface in the other direction, giving the costæ a slightly crenulated or subnodose appearance.

Length, 1.60 inches; height (at the beaks), 0.75 inch; breadth or convexity, 0.69 inch.

In form, this species resembles somewhat varieties of *Pholadomya foliacea*, Agassiz (Étud. Crit. sur les Moll., p. 102, pl. 7, particularly fig. 8), but its beaks are not near so oblique, and located farther back. Its costæ are also smaller and more defined as well as more numerous, while its dorsal outline is more concave.

Locality and position.—Nanaimo, Vancouver's Island, also on New Castle Island; Cretaceous.

Genus GONIOMYA, Agassiz.

GONIOMYA BOREALIS, Meek.

Plate 2, fig. 2.

Pholadomya (*Goniomya*) *borealis*, Meek (1857), Trans. Albany Inst., iv, 41.

Shell transversely subovate or oblong-ovate, moderately compressed; anterior side rather abruptly rounded; posterior extremity truncated; cardinal margin sloping from the beaks, the anterior slope being more abrupt than the other; base forming a broad gentle curve, rounding up more gradually in front than behind; beaks moderately prominent, and located about half-way between the middle and the anterior end. Surface ornamented by from twenty to twenty-five small costæ, which pass down the sides of the shell from the dorsal margin behind and in front of the beaks, so as to meet at acute angles along an imaginary line extending from each beak obliquely backward and downward to near the middle of the base. A few of those near the posterior and anterior ends reach the base before uniting to form an angle. Obscure lines of growth are also seen on portions of the surface.

Length about 1.70 inches; height, 1.12 inches; breadth, 0.65 inch.

The only specimen of this species in the collection is imperfect, being somewhat distorted by pressure, and broken at the extremities. The

curves of its lines of growth, however, give a tolerably correct idea of its outline, and show that its posterior side is rather distinctly truncated. This end also seems to have been gaping, while the other extremity has the appearance of being closed. The substance of the shell is evidently very thin; and it is probable unworn specimens will show the surface to be granular, as usual the case in this and allied genera.

In its general appearance, this species resembles *Goniomya americana*, described by Dr. Hayden and myself from the Upper Cretaceous rocks of the Upper Missouri (see Proc. Acad. Nat. Sci. Philad., viii, 81), but it is proportionally deeper from the beaks to the base, and differs in having the costæ on the posterior side of its valves curving forward, instead of being directed obliquely backward. Other differences will probably be seen on comparing better specimens.

Locality and position.—Nanaimo, Vancouver's Island; Cretaceous.

Genus THRACIA, Leach.

THRACIA ? OCCIDENTALIS, Meek.

Plate 2, figs. 3 and 3 *a*.

Thracia ? occidentalis, Meek (1857), Trans. Albany Inst., iv, 43.

Shell elliptical, moderately compressed, thin and fragile; right valve apparently a little more convex than the other; extremities rather narrowly rounded; outline of base forming a broad semi-elliptic curve; dorsal margin sloping a little in front of the beaks, and less distinctly behind them; beaks nearly central, small, compressed, and not much elevated; postero-dorsal region compressed behind the posterior umbonal slopes. Surface (of worn specimens) showing obscure wrinkles of growth.

Length about 2.08 inches; height, 1.25 inch; breadth, 0.52 inch.

As none of the specimens of this and the following species are in a condition to show the hinge, pallial line, or muscular impressions, it is only provisionally that they have been placed in the genus *Thracia*.

Locality and position.—Nanaimo, Vancouver's Island; Cretaceous.

THRACIA ? SUBTRUNCATA, Meek.

Plate 2, figs. 4 and 4 *a*.

Thracia ? subtruncata, Meek (1857), Trans. Albany Institute, iv, 44.

Shell transversely subelliptical or subovate, thin and moderately compressed, the right valve being a little more convex than the other; anterior side rather narrowly rounded; posterior extremity subtruncated; basal margin forming nearly an elliptic curve, but rounding up more gradually in front than behind; cardinal margin sloping with a slightly convex outline in front of the beaks, and nearly horizontal behind them; beaks subcentral, small, compressed, and but moderately prominent. Surface (of worn specimens) showing traces of rather distinct lines of growth. From immediately behind the beaks, there is (in internal casts) a distinct depression passing obliquely backward and downward just back of the posterior umbonal slope of each valve. Hinge and other internal characters unknown.

Length, 1.84 inches; height, 1.14 inches; breadth about 0.50 inch.

It is possible that this may not be distinct from the last, but, judging from the specimens yet seen, I am inclined to think these two forms belong to different species. That now under consideration differs from

the last in having the posterior side rather distinctly truncated, instead of being narrowly rounded. It seems to be also a proportionally shorter shell, while the oblique depressions (in casts) behind its beaks are deeper and more defined.

Locality and position.—Same as last.

GASTEROPODA.

Genus DENTALIUM, Linnæus.

DENTALIUM KOMOOKSENSE, Meek.

Plate 3, fig. 6.

Dentalium Komooksense, Meek (1857), Trans. Albany Institute, iv, 44.

Shell of medium size, slightly arcuate, and rather distinctly tapering, comparatively thin; section circular. Surface ornamented by elevated longitudinal lines or small costæ, of which about sixteen may be counted near the smaller end, where they about equal the depressions between them in breadth; farther up (toward the larger end), there is between each two of these costæ an intermediate smaller one developed. On following all these costæ to near the middle of the shell, they are seen all to become of nearly uniform size, less distinctly defined, and proportionally more closely arranged. The lines of growth are very fine, obscure, and pass around rather obliquely.

Diameter near the smaller end, 0.05 inch, and increasing to 0.10 inch in a length of 0.50 inch.

This species is nearly related to *D. gracile* of Hall and Meek (Memoirs Am. Acad. Sci. and Arts, Boston, vol. 5, p. 393), from which it may be distinguished by its thinner shell and more slender form as well as by its less distinct lines of growth.

Locality and position.—Nanaimo ?, Vancouver's Island; Cretaceous.

CEPHALOPODA.

Genus BACULITES, Lamarck.

BACULITES CHICOENSIS, Trask?

Plate 4, figs. 2 and 2 *a*, *b*, *c*.

Baculites Chicoensis, Trask (1856), Proceed. San Francisco Acad. Nat. Sci., 85, pl. 2, fig. 2.—Gabb (1864), Report Geol. Survey California, vol. i, 80, pl. 14, figs. 27, 29, and 29 *a*, and pl. 17, figs. 27 and 27 *a*.
Baculites inornatus, Meek (1861), Proceed. Acad. Nat. Sci. Philad., xiii, 316.
Compare *Baculites ovatus*, Say.

Shell apparently attaining nearly a medium size, straight, very gradually tapering, with a regularly ovate section, the antisiphonal side being a little more broadly rounded than the siphonal;* lateral sinuses of the lip

* Until recently, the outer or siphonal side of the *Ammonitoid* forms has been generally called the dorsal side, and the inner the ventral. From the position of *Nautilus* in its shell, however, it has been, with good reason, inferred that the outer side of the Ammonites is really the ventral side. By analogy, we may also infer that the siphonal or narrow side of the Baculites is the ventral side. I have therefore so considered it, and, to avoid confusion, described what used to be called the dorsal lobe as the siphonal lobe, and merely referred to the lateral lobes and sinuses on each side as "*first* and *second* lateral lobes and sinuses". I have also applied the same nomenclature to the Ammonites, merely counting the *number* of the lateral lobes and sinuses, whether many or few.

deep and nearer the antisiphonal side; siphonal projection of lip rather long and linguiform, while that of the dorsal side is nearly semicircular in outline. Surface entirely smooth, or with only obscure lines of growth, curving parallel to the projections and sinuses of the lip.

Septa moderately approximate but not crowded; lobes and sinuses on opposite sides of the shell sometimes differing slightly in their details. Siphonal lobe shorter than the first lateral, and a little more than one-third wider, provided with two rather large, widely-separated terminal branches, with each about six or seven small, short, unequal subdivisions, some of the larger of which are bifid and others trifid. First lateral sinus of about the size of the first lateral lobe, and divided at the extremity into two short, subequal, trifid, terminal branches, with sinuous and obtusely digitate margins. First lateral lobe a little longer than, and about as wide as, the first lateral sinus; on one side of the shell sometimes ornamented by five short, nearly equal, palmately-spreading branches, with from four to five digitations each (see fig. 2 *c*), while on the other it is sometimes divided at the extremity into four unequal branches (see fig. 2 *b*, plate 4), one of which is considerably longer than the others, and more or less distinctly bifid and digitate. Second lateral sinus of nearly the same size and form as the first. Second lateral lobe a little shorter than the siphonal lobe, and about two-thirds as wide, nearly equally divided at the extremity into two short, spreading branches, of which the one on the siphonal side is provided with four short, unequal, digitate subdivisions, and the other into two very unequal branchlets, the larger of which has four or five digitations. Antisiphonal lobe about half as long as the adjacent side of the second lateral lobe, near half as wide as long, and ornamented by four or five digitations on each side.

The largest fragment in the collection measures 1.49 inches in its greater diameter, and 1.13 inches in its smaller, and, judging from its very gradual taper, it appears to have been, when entire, as much as 12 or 15 inches in length.

At the time I proposed the name *B. inornatus* for this species, I only knew Dr. Trask's *B. Chicoensis* from his figures and description of a very small specimen, giving scarcely any idea of the septa of what is now known to be a very young individual of his species. Since seeing Mr. Gabb's figures of the larger specimens of the same shell from the original locality, I am led to think that our Sucia Island specimens may belong to the same species. Of this, however, I cannot be positively sure without a better series of specimens for comparison, particularly as our specimens differ somewhat in the details of their septa from Mr. Gabb's figures, and are still considerably larger than those illustrated by him. In its septa, it agrees more or less nearly with *B. grandis*, H. and M., and *B. ovatus*, Say, but it seems never to attain a size approaching that of the adult shell of either of these forms, while it is destitute of the lateral undulations of the same, so far as can be determined from our specimens, though Mr. Gabb figures one individual that he refers to Dr. Trask's species with these undulations well developed. It is worthy of note, however, that his specimen showing this character differs materially in other respects from our specimens, as well as from the other referred by him to the *B. Chicoensis*.

Locality and position.—Cretaceous of Sucia Islands.

BACULITES OCCIDENTALIS, Meek.

Plate 4, figs. 1, 1 *a*, *b*.

Baculites ovatus (Say?), Meek (1857), Trans. Albany Inst., iv, 48.
Baculites occidentalis, Meek (1861), Proceed. Acad. Nat. Sci. Philad., xiii, 316.

Shell attaining a medium size, very gradually tapering; section subtrigonal, excepting near the smaller end, where it is more nearly ovate; antisiphonal or broader surface flattened so as to give its lateral margins a more or less angular appearance; sides converging with slightly convex outlines from these angles to the narrowly rounded or obtusely angular siphonal margin; aperture subtrigonal, with the antisiphonal margin of the lip nearly semicircular, and that of the siphonal side much longer and somewhat cuneate-sublinguiform, while the lateral sinuosities are rounded with a long, nearly straight, oblique margin on the siphonal side. Surface ornamented with small, obscure, regular undulations, extending across from the dorso-lateral angles to or beyond the middle of each side, with a regular curve parallel with the margins of the lateral sinuosities of the lip. Fine rather regular but obscure lines of growth also run parallel to the curves of the lip margin.*

Septa neither crowded nor very distant. Siphonal lobe somewhat shorter than the first lateral lobe, and twice as wide, provided with two rather large, widely-separated terminal branches, each of which is bifid, the subdivisions being armed with numerous unequal, rather sharp digitations. First lateral sinus of about the breadth of the siphonal lobe, near one-third longer than wide, and deeply divided at the extremity into two nearly equal branches, each of which is tripartite, with short obtuse sinuosities and digitations. First lateral lobe as long as the second, but only about two-thirds as wide, and provided with three principal branches on each side, the two terminal of which are a little larger than the succeeding lateral divisions, and each armed with from six to eight or nine small unequal branchlets and digitations. Second lateral sinus a little broader than the first, but in other respects very similar to it, excepting in having its corresponding branches on opposite sides. Second lateral lobe nearly as wide as long, its antisiphonal side being only about half as long as the other, owing to the shortness of the antisiphonal sinus, provided at the extremity with four palmately-spreading branches, the two inner of which are larger than the others, rather widely separated, and each irregularly trifid and more or less digitate. Antisiphonal lobe about half as long as the longer side of the second lateral lobe on each side, lance-ovate in form, and provided with some five or six digitations on each lateral margin, one of which near the middle of each side is considerably longer than the others.

The specimens yet known being all imperfect, it is not possible to give accurate measurements from them; though, as nearly as can be determined from the taper of the longest fragments in the collection, the average length of a specimen measuring 1.45 inches in its greater diameter at the larger end would appear to have attained a length of 12 to 15 inches.

Although I continue to regard this form as being specifically distinct from the last, I am prepared to believe that more extensive collections may yet show it to be only a variety of that species. So far as yet

* On each side of the specimen represented by fig. 1 of plate 4, there is a curious backward flexure of the lines of growth along an imaginary line near each dorso-lateral angle as seen at (*a*) of the figure mentioned. As this character, however, is only seen on this one specimen, it is doubtless due to some accident.

known, however, it differs in the details of its septa, while in the peculiar flattening of its dorsal or antisiphonal side it differs not only from the last but from any other species of the genus known to me. I noticed this peculiarity in the specimen first referred provisionally to Say's *B. ovatus*, but supposed it due to some accident. The collections subsequently obtained, however, show that it is not due to accidental pressure. It must be remembered, however, that individuals of the same species in this genus are subject to some variations of form as well as of the details of the septa; while they often present so few characters upon which to found species that their proper classification is generally very difficult, excepting to those who would refer all such forms throughout the world to the single species *B. anceps* of Europe. This form bears somewhat the same relations to the last that *B. compressus*, Say, bears to his *B. ovatus*, its septa being very like those of the former; so far as known, however, it seems never to be so compressed as *B. compressus* at any stage of growth.*

Locality and position.—Same as last.

Genus HETEROCERAS, d'Orbigny.

HETEROCERAS COOPERI, Gabb (sp).

Plate 3, figs. 7 and 7 *a*.

Ammonites ? Cooperi, Gabb (1864), California Geol. Report, i, 69, pl. 14, figs. 23 and 23 *a*.

Of this fossil, there is in the collection but a single non-septate fragment, measuring 3.50 inches in length and about 1.90 inches in its greatest breadth; the section being slightly oval. It is evidently a part of a spiral shell, with rounded disconnected whorls; and, judging from its curve, it must have possessed a much larger umbilical space than is seen in *Turrelites*. As it is very much larger than any known *Helicoceras*, it would seem to have belonged to the non-septate part of a shell allied to *Heteroceras*. Its surface is ornamented by moderately distinct annular costæ, which pass around rather obliquely. Two rows of nodes also occur on the outer or dorsal side, at which points the costæ usually bifurcate.

I refer this shell with much doubt to the species described by Mr. Gabb under the name *Ammonites ? Cooperi*, which it seems probable was founded on a fragment of a *Heteroceras*. Mr. Gabb referred his species doubtfully to the genus *Ammonites*, as he had only mere fragments for study.

Locality and position.—Komooks, Vancouver's Island: Cretaceous.

Genus AMMONITES, Brnguière.†

AMMONITES NEWBERRYANUS, Meek.

Plate 4, figs. 3, 3 *a*, and 3 *b*.

Ammonites Newberryanus, Meek (1857), Trans. Albany Institute, iv, 47 (not *A. Newberryanus*, Gabb. (1864), Geol. Report California, i, 61, pl. 27).

Shell discoid, moderately compressed, rounded on the periphery; umbilicus of moderate depth, less than one-third the greater diameter

*Since this was written I have ascertained that *large* specimens of *B. compressus* show a tendency to present a similar subtrigonal section (see Invert. Palæont. Upper Mo., 403), from which it would appear that this Vanconver form may be more nearly related to *B. compressus* than has been suspected.

†None of the species here described belong properly to the genus *Ammonites*, as restricted by late investigators of the family *Ammonitidæ*. As the Cretaceous groups of

of the shell; volutions five and a half or more, increasing very gradually in size, diameter from ventral to dorsal side nearly or quite equaling their transverse breadth—all rather deeply embracing, so as to conceal more than half of each inner turn. Surface ornamented by distinct rounded costæ, which occasionally bifurcate near the umbilicus and about half-way across toward the periphery, in crossing which they curve slightly forward; depressions between the costæ generally about equaling the latter in size, but, at intervals of about five or six times to each turn, a deep sulcus or constriction is seen on internal casts, produced by the occasional thickening of the lip, at regular intervals of about every fifth of each turn. A single row of small transversely-elongated nodes surrounds the umbilicus.

Septa deeply divided into six or seven principal lobes on each side, which diminish regularly in size from the first lateral lobe to the umbilicus. Siphonal lobe about the size of the first lateral sinus, oblong in form, and provided with three principal branches on each side, the two terminal of which are larger than the others, and each irregularly subdivided into two or three small branchlets and a few sharp digitations. First lateral sinus deeply divided at the extremity into two subequal parts, and provided on each side behind these with two or three irregular alternating lateral branches—the two terminal divisions being much larger than the others, and each irregularly tripartite, with sinuous and digitate margins. First lateral lobe about the size of the first lateral sinus, palmately divided at the extremity into three large irregular branches, with each three or four sharp unequal digitations at the end; while above these terminal divisions, the sides of the lobe are each ornamented by two or three smaller alternating sinuate lateral branches. Second lateral sinus smaller than the first lateral lobe, and having on each side two or three irregular alternating lateral divisions, while the extremity is divided into two unequal terminal branches, each of which is again divided into two or three small branchlets, with sinuous margins. Second and third lateral lobes much smaller than the first lateral, but somewhat similarly branched, their divisions being, however, proportionally shorter. The three or four remaining lobes are very small, a little oblique, and merely digitate.

The specimen from which the foregoing description was made out measures 2.28 inches in its greatest diameter and 0.90 inch in convexity. As it consists entirely of septate whorls, it is probable that the outer volutions of adult individuals may vary somewhat in their external ornaments, as well as in the details of their septa, from the specimen under examination.

In form and other external characters, this species is nearer like *A. mutabilis* of Sowerby (Min. Conch., iv, 145, pl. 405) than any other shell with which I am acquainted. I have not had an opportunity to see the septa of that species; but if it is, as some think, not distinct from *A. Koenigii*, Sowerby, our Vancouver species may be readily distinguished by its more deeply-lobed septa.

Named in honor of Prof. John S. Newberry, State geologist of Ohio, and professor of geology in the School of Mines, Columbia College, New York.

Locality and position.—Same as last.

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these Cephalopods have not yet been classified, however, in accordance with the prevalent modern views, and I have not the necessary material at hand to determine the exact relations of our species to some of the proposed genera, I have concluded to leave part of them, for the present, under the old genus *Ammonites*, as understood in its most comprehensive sense.

AMMONITES COMPLEXUS ?, *var.* SUCIAENSIS.

Plate 5, figs. 2 and 2 *a*, *b*, *c*.

Ammonites complexus, Hall and Meek (1856), Mem. Am. Acad. Arts and Sci. Boston, v, (new series), 394, pl. 1, fig. 1, *a–f*.
Ammonites complexus, var. *Suciaensis*, Meek (1861), Proceed. Acad. Nat. Sci. Philad., xiii, 317.
Ammonites Suciaensis, Gabb (1869), California Geol. Report, i, 133, pl. 21, figs. 11 and 11 *a*, *b*

Shell attaining a moderate size, discoid, rounded on the periphery; umbilicus shallow-crateriform, about half as broad as the outer volution from the dorsal to the ventral side, and showing nearly one-third of each inner turn; volutions apparently about five or six, increasing rather gradually in size, last one very slightly compressed on the sides, and rounding to the periphery and umbilicus, all deeply embracing. Surface ornamented by transverse costæ, which, in the very young shell, appear to be merely little elongated nodes near the umbilicus, but in a more advanced stage of growth cross the sides, and pass straight over the periphery as narrow low ribs, separated by wider flattened depressions, while on the outer turn of large shells they seem to be nearly obsolete; between each two of those that extend inward to the umbilical side, there is usually one, or sometimes two, that become obsolete before reaching the inner margin, while those that extend entirely across swell a little near the umbilicus so as to show a tendency to develop obscure, elongated nodes.

Septa profoundly divided into slender, variously-branched, and digitate lobes and sinuses. Siphonal lobe nearly as large as the first lateral lobe, and ornamented on each side by four branches, which increase in size, and become more subdivided toward its extremity, the two terminal divisions being considerably larger than the others, and each divided into four or five unequal digitate, spreading branchlets. First lateral sinus as large as the siphonal lobe, about one-third longer than wide, slender and flexuous near the base, and very deeply divided above into two subequal slender branches, each of which is subdivided so as to form three or four unequal, more or less bifurcating, and deeply sinuous branchlets. First lateral lobe one-third longer than wide, and ornamented at the extremity by three great spreading, nearly equal, branches, each of which is subdivided into three or four principal branchlets, with numerous smaller digitate subdivisions. Second lateral sinus as long as the first, but narrower, and very similarly divided. Second lateral lobe nearly two-thirds as large as the first, and closely resembling it in its branches and subdivisions. Third lateral lobe about half as large as the second, with somewhat similar but less deeply-divided branches.

There are three or four other much smaller lobes between the third lateral lobe and the umbilicus, which are very oblique, and each more or less distinctly trifid and digitate at the extremity.

I have endeavored to give a full and detailed description of this shell, because, after a very careful comparison, I am left in doubt whether it should be regarded as a variety of *A. complexus* (Hall and Meek) or as a distinct species. It certainly is a much more compressed shell, the volutions of *A. complexus* being nearly twice as wide transversely as from the dorsal to the ventral side, while these two diameters of the whorls in the form before me are nearly equal. Differences of this kind, however, are not generally reliable as a means of distinguishing species in this group; though the few specimens of *A. complexus* yet brought

from Nebraska, as well as those found in New Jersey, do not show any essential variations in this respect.

In the relative size, number, and arrangement, as well as in the mode of branching, of its lobes and sinuses, the shell under consideration agrees very nearly with authentic specimens of *A. complexus*; though in the details of the divisions of its septa there are differences from those of that form. Still these differences, as may be seen from the figure given on plate 5, seem to be of such a nature that they may be due to different degrees of development in the specimens compared; the few individuals of *A. complexus* yet found, either at the original locality or in New Jersey, being smaller than those of the form under consideration with which I am comparing them. That first figured by Professor Hall and the writer is not in a condition to give a clear idea of the septa of the Nebraska shell.

In the lobes and sinuses of its septa, this species is also very closely allied to *A. Gollevillensis*, d'Orbigny (=*A. Lewisiensis*, d'Orb., not Sowerby). It is a more gibbous shell, however, and differs in having its costæ developed entirely across to the inner side of its whorls, while its periphery is completely destitute of the longitudinal groove so characteristic of d'Orbigny's species.

It is also nearly related to *A. Egertonianus*, Forbes, from the Cretaceous of India, but its volutions are less compressed, its costæ smaller, and its septa different in some of their details, particularly in the arrangement of the small inner lobes near the umbilical margins.

The largest specimen in the collection is from Sucia Islands. It is an internal cast, and has its outer turn so much worn as to obliterate much of the details of the lobes and sinuses, as may be seen by fig. 2 *b* of plate 5. The inner turns, however, when separated, show the septa very clearly. It consists entirely of septate whorls, the non-septate portion having been broken away. In its greatest diameter, it measures 4.60 inches, and 1.90 inches in breadth. Others (retaining most of outer chamber) measure about 3.15 inches in their greater diameter.

Locality and position.—Komooks, Vancouver's Island, and at Sucia Islands; Cretaceous.

Genus PLACENTICERAS, Meek.

PLACENTICERAS ? VANCOUVERENSE, Meek.

Plate 6, fig. 1, 1 *a*, 1 *b*, and 1 *c*.

Ammonites Vancouverensis, Meek (1861), Proceed. Acad. Nat. Sci. Phila., xiii, 317.

Shell discoidal; volutions increasing rather gradually in size, strongly compressed on the sides, and flattened on the narrow periphery, nearly twice as broad from the peripheral to the umbilical side as the transverse diameter, and rather deeply embracing; umbilicus of moderate depth, and small, or rather less than half as wide as the greater diameter of the outer whorl; aperture (as nearly as can be determined from a section of one of the whorls) compressed-subcordate. Surface ornamented by a row of compressed nodes along each margin of the periphery, and another of smaller size around the umbilicus of each side; about twenty of the first and ten of the latter may be counted on each side of an entire turn. The flattened sides between the peripheral and umbilical rows of nodes are provided with obscure, slightly-arching, transverse costæ, one of which extends from each of the umbilical nodes toward the peripheral margin; but all become obsolete before reaching it, at least on the outer turn. Between each two of these principal

costæ, one or two more very obscure ones are seen, which do not reach either the peripheral or umbilical margin.

The septa are strongly undulating, and irregularly divided into very unequal principal and subordinate lobes and sinuses on each side. Siphonal lobe comparatively small, and provided with three short branches on each side, the two terminal of which are a little larger than others, slightly spreading, and merely a little dentate on their margins; first lateral sinus about twice as large as the siphonal lobe, and very unequally divided into three branches, the outer one of which is largest, and truncated at the end, with four short, nearly simple, subdivisions, while the middle branch is smallest, with merely deeply sinuous margins, and the third one is tripartite and directed nearly inward toward the umbilical side; first lateral lobe small, slender, very oblique, bipartite, with unequal bifid terminal branches; second lateral sinus scarcely larger than the oblique branch on the inner side of the first, very oblique, with an extremely contracted body, and two or three alternately-arranged, short, sinuous branches on each side; second lateral lobe longer than the first, somewhat arcuate, with a slender body, a trifid extremity, and three or four short, alternately-arranged, slightly dentate, lateral branches; third lateral sinus smaller than the second, with a proportionally less contracted body, and about three short, alternating, unequal, nearly simple, lateral branches, and a small, simple, subglobose, terminal division; third lateral lobe projecting a little beyond the second, and almost exactly like the first, excepting that its corresponding branches are on the opposite sides; fourth lateral sinus extremely broad, or more than equaling the breadth of the first, which it also nearly equals in length, slightly divided at the end into two nearly equal, short, broad divisions, with more or less sinuous margins; fourth lateral lobe nearly as large as the third, but owing to the undulating arrangement of the whole series, much less prominent, divided at the end into two short, equal, bifid branches, with obscurely dentate margins; fifth, sixth, and seventh lateral lobes of nearly equal size, and scarcely half as long and wide as the fourth, with merely dentate extremities and lateral margins—all separated from each other by lateral sinuses of about the same size.

I was at one time of the opinion that the three divisions of the septa here described as the first, second, and third lateral lobes formed, together with the great undulation of the suture with which they connect, one enormously-developed first lateral lobe, which would also make the very broad sinus I now view as the fourth, the second lateral sinus. It now seems to me, however, from analogy, on comparison with the sutures of *Placenticeras placenta* (=*Ammonites placenta*, DeKay), that the view taken in the above description of the septa is the proper one.

The specimen from which the figure and description of this species were made out consists of about one-half of one volution, most of which is non-septate. When entire, the shell must have measured not less than 4 inches in its greatest diameter, and about 1.13 inches in convexity.

Locality and position.—Komooks, Vancouver's Island; Cretaceous.

Genus PHYLLOCERAS, Suess.

PHYLLOCERAS? RAMOSUS, Meek.

Plate 5, figs. 1, 1 *a*, and 1 *b*.

Ammonites (*Scaphites?*) *ramosus*, Meek (1857), Trans. Albany Institute, vol. iv, 45.—Gabb, (1864) Geological Report of California, vol. i, 65, pl. 11, figs. 12 and 12 *a*; and pl. 12, fig. 12 *b*.

Shell oval-discoid in form, compressed, very thin and fragile; narrowly rounded on the periphery; umbilicus very small, but not entirely closed;

volutions increasing rather rapidly in dorso-ventral diameter, and more gradually in convexity, compressed so as to be nearly flat on the sides, but rounding a little into the immediate umbilicus and to the periphery, each so deeply embracing as to hide all the preceding ones. Surface ornamented by numerous fine, regular, nearly simple, transverse lines, which increase very gradually in size from the inner to the outer whorls, and in crossing the sides curve first gracefully forward near the umbilicus, then, after passing the middle, arch slightly backward, and again a little forward in passing over the periphery.

Septa extremly complex, being crowded together and very deeply divided into variously-branched lobes and sinuses, which diminish regularly in size from the peripheral margin to the umbilicus. Siphonal lobe covering between one-half and one-third as much space as the first lateral lobe, and having on each side three branches, of which the two at the extremity are much larger than the others, and each divided nearly to its base into two unequal slender branchlets, with several smaller subdivisions and sharp digitations; first lateral sinus a little larger than the siphonal lobe, very oblique at its base, and profoundly divided at its extremity into two large, unequal, slender branches, which are variously subdivided and sinuous; first lateral lobe slender, but spreading its deeply-divided branches over a surface nearly twice as large as that occupied by the first lateral sinus, ornamented at the extremity by three large, unequal, spreading branches, which are each irregularly subdivided into from four to six or seven branchlets, with numerous pinnæ and smaller digitations; second lateral sinus nearly half as large as the first lateral lobe, contracted and oblique below, and having at its extremity four unequal divisions, three of which are trifid and the other bifid, and all provided with numerous irregular subdivisions with sinuate margins; second lateral lobe less than half as large as the first, and divided into about seven principal alternating branches, of which the three nearest the extremity are larger than the others, and each again divided into two more or less sinuous and digitate parts.

The remaining three or four lobes diminish regularly in size, and become less branched toward the umbilicus; the third, fourth, and fifth being palmately divided at the extremity into five, four, and three short, unequal branches, while those nearer the umbilicus are more nearly simple, or only ornamented by a few small digitations.*

In the structure of its septa, this is one of the most complex species I have ever seen; the surface of the cast being so completely covered by the numerous slender branches of the lobes and sinuses as to render it exceedingly difficult to follow their various ramifications. Yet, from all analogy, they are doubtless even more complex in the outer whorls of large adult specimens, since that before me measures only 1.90 inches in its greater diameter, and 0.53 inch in convexity; while impressions left in the matrix of some of the specimens show that some individuals are not less than five inches in their greater diameter.

In form and surface-markings, it is much like *Ammonites Velledæ* of Michelin, as figured by d'Orbigny on plate 82 of his palæontology of France, vol. i (Cretaceous), though it is more compressed. Yet this slight external difference, if not accompanied by well-defined peculiarities in the lobes and sinuses of the septa, would not be sufficient to dis-

* The typical specimen does not show the lobes and sinuses of the septa very clearly beyond the siphonal and first lateral lobes and the first lateral sinus; but Mr. Gabb's California specimen, which did not show the siphonal lobe, exhibits all of the other lobes and sinuses very clearly.

tinguish these forms. When we compare the septa, however, they are at once seen to present marked differences, such as are clearly incompatible with specific identity, if d'Orbigny's figures are accurately drawn. It is also closely allied to *A. Morelianus*, d'Orbigny, but differs in the structure of its septa.

Locality and position.—Cretaceous beds at Komooks, Vancouver's Island; also in the lower division of the California Cretaceous at Cottonwood Creek, Shasta County, of that State.

Genus NAUTILUS, Linnæus.

NAUTILUS CAMPBELLI, Meek.

Plate 6, figs. 2 and 2 *a*.

Nautilus Campbelli, Meek (1861), Proceed. Acad. Nat. Sci. Philad., 318.

Shell large, subglobose, or somewhat oval, moderately convex; periphery and sides rounded or slightly compressed; volutions increasing rather gradually in size, deeply embracing, and rounding into the umbilicus on each side; umbilicus very small, but not quite closed; septa separated by spaces less than one-third the transverse diameter of the whorls at the point of measurement, arching slightly backward on the sides and periphery; aperture nearly circular, but deeply sinuous on the ventral side for the receptions of the inner whorls. Siphuncle and surface-markings unknown.

Length, or greatest diameter, 4.83 inches; breadth, or transverse diameter, 3.07 inches.

This fine *Nautilus* is much like *N. Clementinus*, d'Orbigny, as figured in his Paléont. Français, Terr. Crét., i, pl. 13 bis. It differs, however, in having a more rounded aperture and a more broadly-rounded periphery, the entire shell being less compressed.

It is perhaps more nearly allied to some varieties of the Indian form referred by Dr. Stoliczka to *N. Bouchardianus*, d'Orbigny (= *N. lævigatus* and *N. sphæricus*, Forbes), some of which seem to be nearly as much compressed. None of these forms, however, show near so rounded an aperture or section of the volutions. Yet it is extremely difficult to distinguish these smooth *Nautili* of this type with such specimens as we usually get for study, and it is therefore possible that more extensive collections may show it to be necessary to unite the Vancouver shell with one of these foreign species.

It may be at once distinguished from *Nautilus Dekayi* (which has been identified by Dr. Shumard from Vancouver's Island) by its much more compressed form, narrowed aperture, and slightly open umbilicus, that of *N. Dekayi* being entirely closed at all ages by a solid shelly columella. Its whorls are also more compressed on the sides, and more concave in the region of the umbilicus, thus giving a very different form to its aperture and the section of its volutions.

The specific name was given in honor of Mr. Archibald Campbell, the commissioner in charge of the Northwestern Boundary Survey.

I have given on the same plate (Fig. 3) for comparison, an outline showing a transverse section of one of the whorls of *Nautilus Dekayi*, taken from Dr. Morton's original specimen, in the collection of the Academy of Natural Sciences at Philadelphia.

Locality and position.—Komooks, Vancouver's Island; Cretaceous.

TERTIARY SPECIES?

Genus MACTRA, Linnæus.

MACTRA GIBBSANA, Meek.

Plate 2, figs. 8, 8 *a*, and 8 *b*.

Mactra Gibbsana, Meek (1861), Proceed. Acad. Nat. Sci. Philad., xiii, 315.

Shell transversely oval, or subtrigonal, moderately convex, rather thin; anterior side narrowly rounded; base forming a regular semi-elliptic curve; posterior side slightly truncated at the immediate extremity, abruptly rounded or subangular at its connection with the base below; dorsal outline sloping from the beaks in front and behind at an angle of about 120°; beaks central, rather elevated, but small, and not projecting much above the hinge-margin; surface marked only by moderately distinct lines of growth. Posterior muscular impression oval, well defined; pallial line distinct, and provided with a rather deep, horizontal sinus, which is about one-third longer than wide.

Length, 2.04 inches; height, 1.50 inches; breadth or convexity, 1 inch.

Some eight or ten more or less perfect valves of this species were found near Port Discovery on the Straits of Fuca in a loose mass of rather hard, fine, gray sandstone, in which (when moistened and examined with a magnifier) numerous black grains may be seen. So far as I am able to determine, it belongs to an undescribed species, which I proposed to name in honor of Mr. George Gibbs, the geologist of the Boundary Survey. As the matrix in which it is embedded contains no other fossils, excepting fragments of an unknown Univalve, I have been unable to decide whether it is of Tertiary or Cretaceous age, though I incline to the opinion that it belongs to the former.

Mr. Conrad has described a similar *Mactra* under the name of *M. albara* from the Tertiary on the Columbia River (Am. Jour. Sci., vol. v, 2d series, 432). The species before me, however, is proportionally longer and less gibbous. It also differs in being destitute of a distinct angle down the posterior umbonal slopes. It is likewise proportionally longer than any of the Cretaceous species described by Dr. Hayden and myself from Nebraska.

Locality and position.—Found loose on the Straits of Fuca; Cretaceous or Tertiary.

PLATE 1.

Page.

FIG. 1. PRODUCTUS LATISSIMUS; cast of interior of ventral valve, reduced to a little less than one-third diameter 354

1 *a*. Outline profile of same.

1 *b*. Surface-striæ of same, magnified.

FIG. 2. ATHYRIS SUBTILITA ?, ventral view, reduced in same way 355

2 *a*. Dorsal view of same.

FIG. 3. SPIRIFER KEOKUK ?, ventral view, reduced in same way 355

3 *a*. Ventral view of a smaller individual, apparently of the same species, but proportionally shorter on the hinge-line; reduced in same way.

FIG. 4. An undetermined bivalve, presenting the form and external appearance of a MACTRA or TANCREDIA; from New Castle Island, Nanaimo group, reduced in size as above.

4 *a*. Outline profile of same.

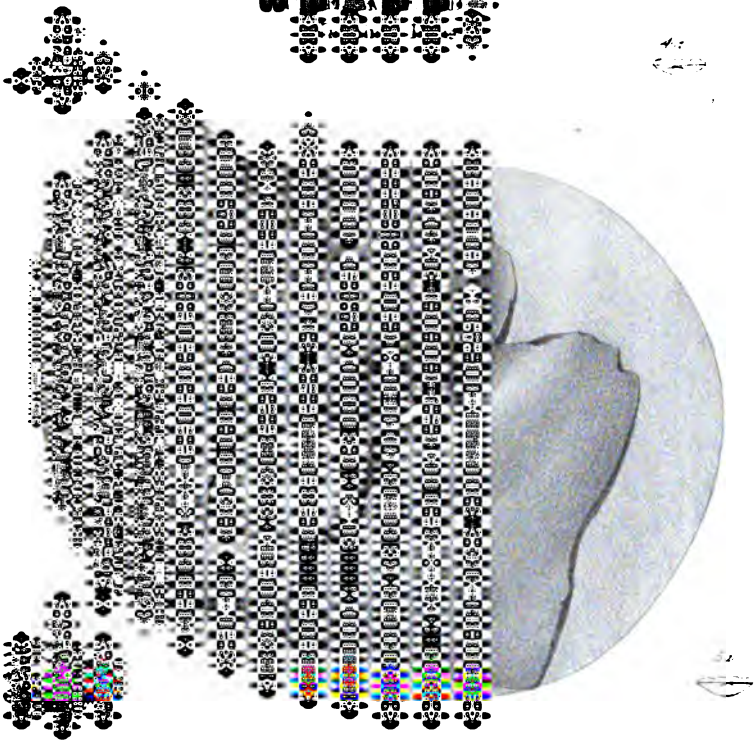
FIG. 5. Undetermined bivalve from same locality and position as last, reduced in same way.

5 *a*. Profile outline of same.

FIG. 6. INOCERAMUS ——— ? Imperfect cast of a left valve, reduced in size as above 359

The dim shading beyond the broken posterior and basal margins represents the restored outline.

NOTE.—The figures on this and the following five plates were originally, in most cases, drawn of natural size, and arranged for quarto plates; but the whole were reduced for this work to octavo size by photographs, from which the lithographer made his tracing, and then finished the figures from the original drawings.



Th.ᵐ Sinclair & Son, lith., Phila.

PLATE 2.

Page.

FIG. 1. PHOLADOMYA SUBELONGATA; reduced to less than two-thirds the natural diameter 362

1 *a*. Dorsal view of same.

FIG. 2. GONIOMYA BOREALIS 362

A left-side view, reduced in the same way.

FIG. 3. THRACIA? OCCIDENTALIS; reduced as above 363

3 *a*. Dorsal view of same.

FIG. 4. THRACIA? SUBTRUNCATA; reduced in same way 363

4 *a*. Dorsal view of same.

FIG. 5. CYPRIMERIA? TENUIS; mould of exterior surface left in matrix, reduced in size 361

5 *a*. An internal cast of a smaller specimen; reduced.

5 *b*. Profile of same.

FIG. 6. ARCA EQUILATERALIS; side view of an internal cast, showing muscular impressions and traces of radiating striæ, reduced in size as above.. 357

6 *a*. Dorsal view of same species.

FIG. 7. TRIGONIA EVANSI; side view of the original imperfect specimen, reduced in size, and retaining portions of the shell 359

7 *a*. Side view of a gutta-percha cast, taken from a nearly perfect mould or impression left in the rock; reduced in size.

7 *b*. A dorsal view of a cast from a mould left in the rock; reduced in size.

FIG. 8. MACTRA GIBBSANA; reduced in size (age doubtful) 374

8 *a*. Portion of an internal cast, showing the posterior muscular impression and the pallial line of same species; reduced as above.

8 *b*. Outline anterior view of same species.

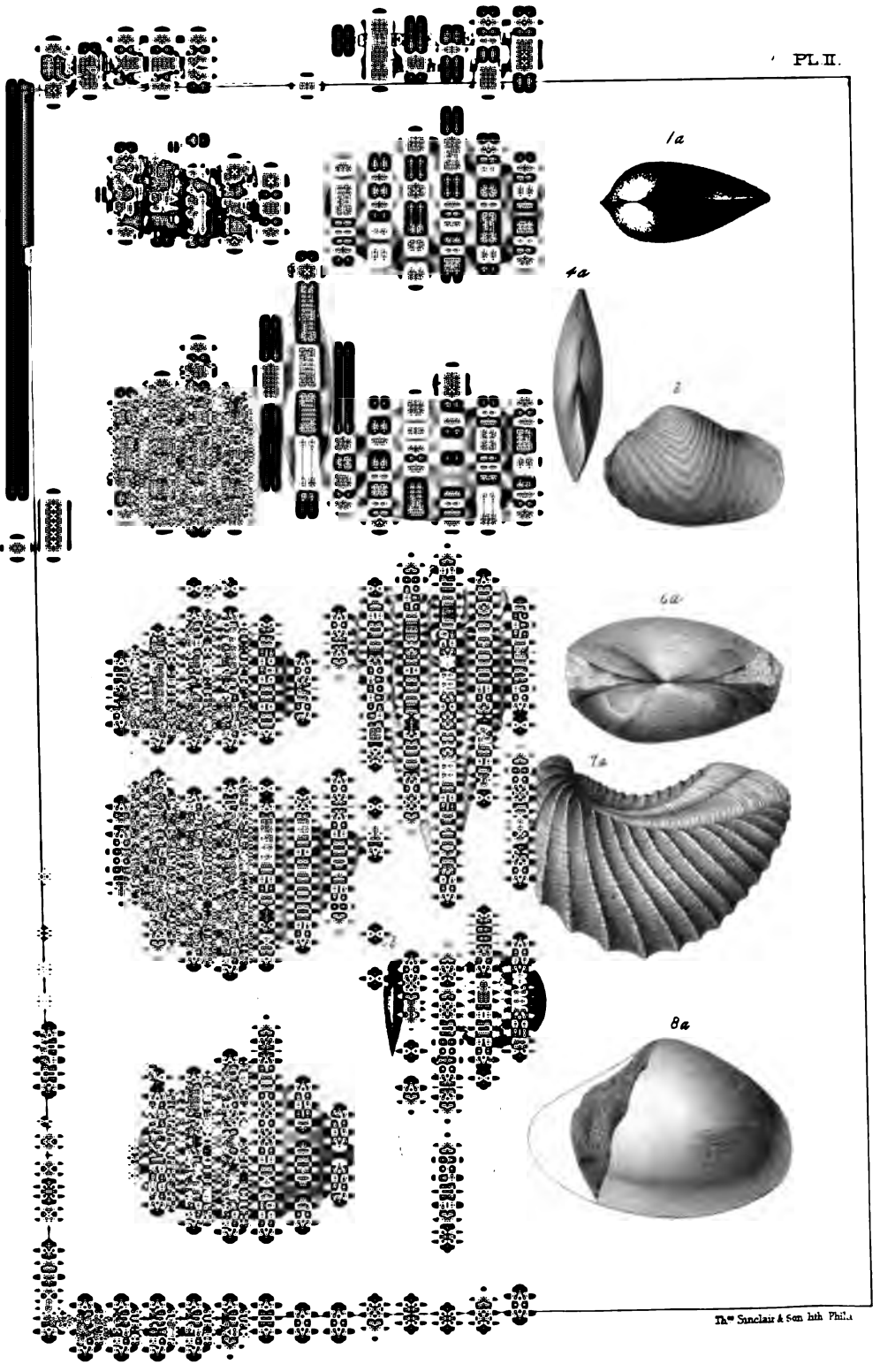


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PLATE 3.

Page.

FIG. 1. INOCERAMUS CRIPSII, *var.* SUBUNDATUS; right valve, reduced to less than two-thirds the natural diameter 358

1 *a*. Profile of same, in outline.

FIG. 2. Outline view of one of Morton's original specimens of *Inoceramus Barabini*, for comparison with figs. 1 and 3; reduced as above.

2 *a*. Profile of same.

FIG. 3. INOCERAMUS CRIPSII, *var.* SUBUNDATUS; left valve, reduced as above ... 358

3 *a*. Outline profile of same.

FIG. 4. CARDIUM (PROTOCARDIA) SCITULUM; cross-lines showing natural size... 360

4 *a*. Right valve, enlarged.

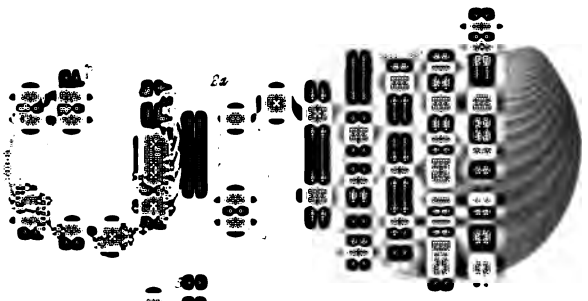
FIG. 5. GRAMMATODON? VANCOUVERENSIS; right valve, reduced as above..... 357

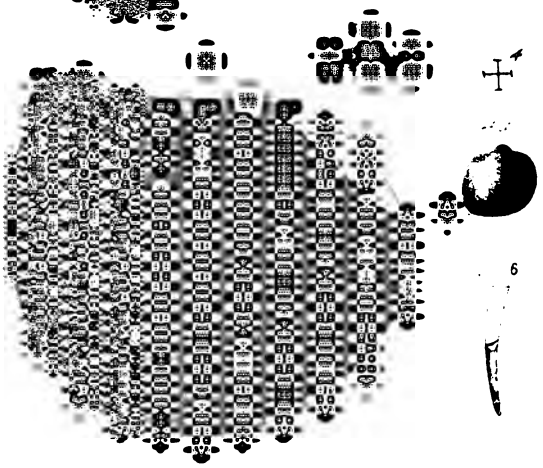
5 *a*. Profile view of same.

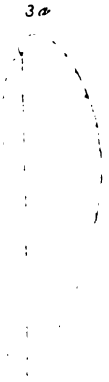
FIG. 6. DENTALIUM KOMOOKSENSIS; reduced as above..... 364

FIG. 7. HETEROCERAS COOPERI; view of outer or dorsal side, reduced as above. 367

7 *a*. Ventral side of same.







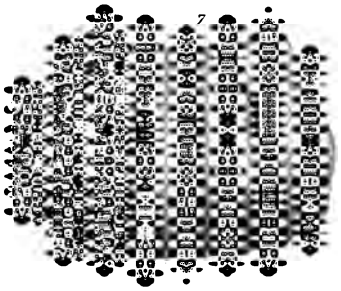


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PLATE 4.

Page.

FIG. 1. BACULITES OCCIDENTALIS; reduced to less than two-thirds the natural diameter 366

1 *a*. Section of same.

1 *b*. A septum of same, enlarged to about 2 diameters.

FIG. 2. BACULITES CHICCOENSIS; reduced as above 364

2 *a*. Section of same.

2 *b*. A septum of same, enlarged to about 2½ diameters.

2 *c*. First lateral lobe of same, on the opposite side (enlarged in same way), showing the differences in the details of this lobe on the two sides of the shell.

FIG. 3. AMMONITES NEWBERRYANUS; side view reduced to about two-thirds the natural diameter 367

3 *a*. Peripheral view of same.

3 *b*. A septum of same, enlarged to about 3 diameters.

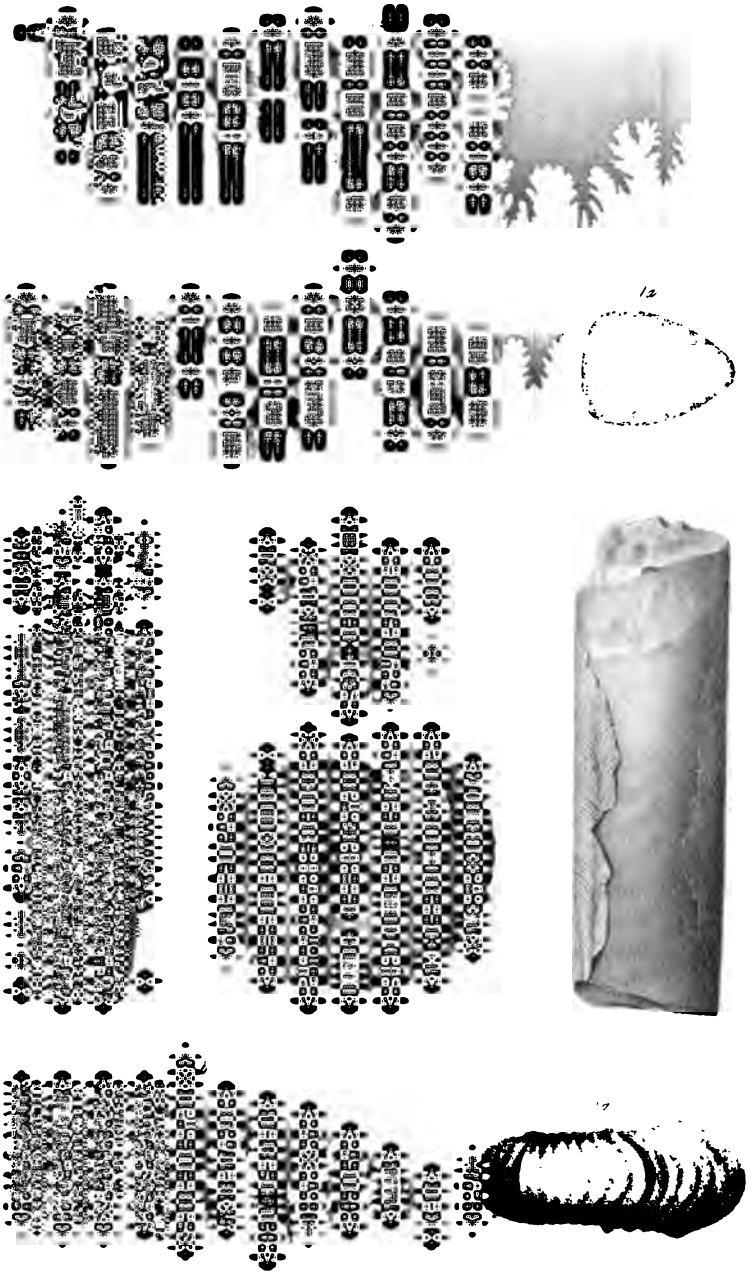

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PLATE 5.

Page.

FIG. 1. PHYLLOCERAS RAMOSUS; side view, reduced to about two-thirds the natural diameter 371

1 *a*. Outline profile view of same.

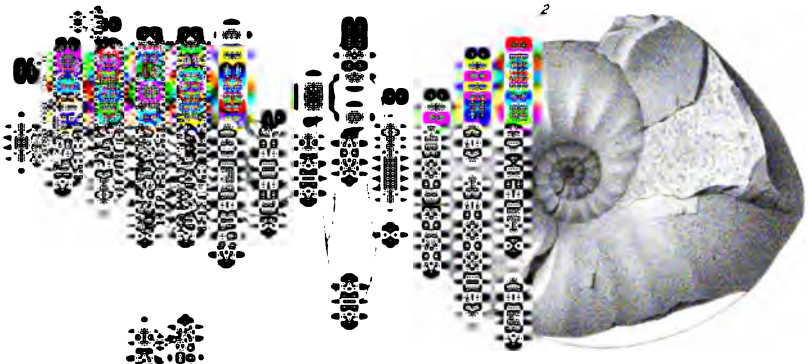
1 *b*. Part of a septum of same, showing the siphonal and first lateral lobes and the siphonal sinus, magnified.

FIG. 2. AMMONITES COMPLEXUS, *var.* SUCIAENSIS; side view of a medium-sized specimen from Komooks, reduced to about two-thirds the natural diameter 369

2 *a*. A part of a septum of same, enlarged.

2 *b*. A larger specimen from Sucia Island, being a worn internal cast, reduced as above.

2 *c*. Profile view of same. The siphonal lobes of the septa in this figure are traced in from the smaller specimen represented by fig. 2 of same plate.



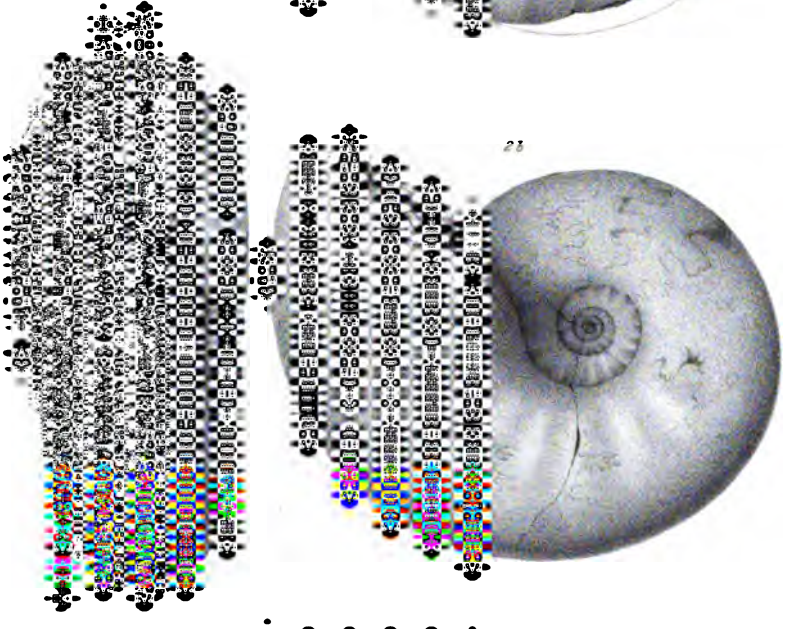


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PLATE 6.

Page.

FIG. 1. PLACENTICERAS ? VANCOUVERENSIS; dorsal view, reduced to about two-thirds the natural diameter 370

1 *a*. Lateral view of same.

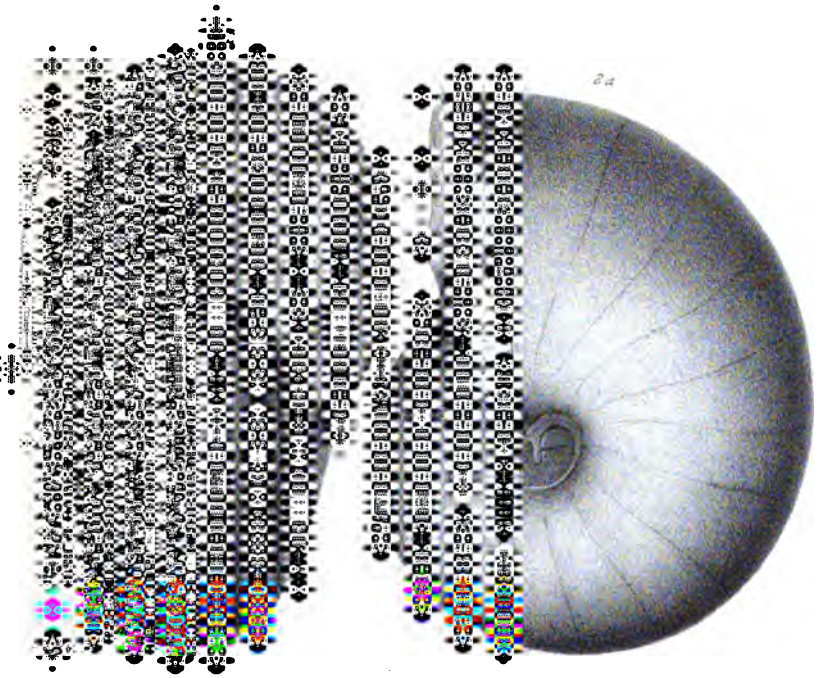
1 *b*. Septum of same, enlarged to 3 diameters.

1 *c*. A section of one of the whorls.

FIG. 2. NAUTILUS CAMPBELLI; anterior view, reduced to about two-thirds the natural diameter 373

2 *a*. Lateral view of same.

FIG. 3. An outline section of one of the whorls of *Nautilus Dekayi*, taken from Dr. Morton's original specimen; reduced to about two-thirds the natural diameter.



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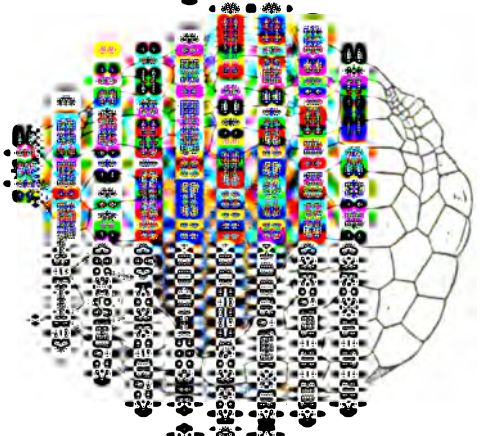

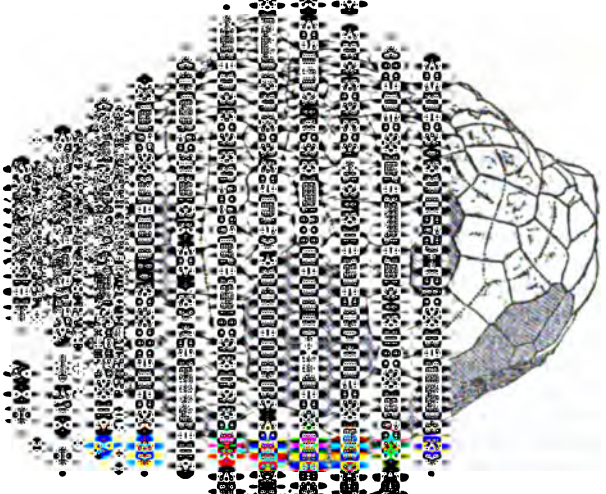

[illegible]-bases, &c., with some of the

[illegible] excepting that all the body-
[illegible]ial area (middle of figure) and
[illegible]e of two of the interaxillary
[illegible] the radial system, which lat-

In the July number of the American Journal of Science for this year (1876), vol. xii, page 81, Mr. G. B. Grinnell, of New Haven, has described a very interesting new genus and species of *Crinoidea*, from the Cretaceous rocks of the West. This fossil was first discovered by Professor Marsh, some years back, in Utah, and has since been found in Kansas. Professor Mudge had also sent specimens of it to me last winter from Kansas, and I had in course of preparation the accompanying cuts, with the view of illustrating and describing it; but on learning from Professor Marsh that Mr. Grinnell was about to describe it, my name and description were withheld from publication.

Mr. Grinnell kindly sent me, soon after, a copy of his description and figures in advance of the issue of the Journal of Science in which they are published; and on examining these, I find that our specimens show some parts of its structure more clearly than those studied by him. Consequently, it seems desirable that our cuts, with some additional remarks on this curious Crinoid (the only known American Cretaceous type of the order), should be published.

Like those investigated by Mr. Grinnell, none of our specimens are in a condition to show the base of the body; but from its general physiognomy as presented in our specimens, and more especially from the entire absence among the numerous associated fragments, of any disks of columns, I think Mr. Grinnell very probably right in supposing that it may have had no column, or, in other words, may have been free.

As nearly as can be determined from the specimens yet known, the body of the type-species seems to have presented a slightly depressed-subglobose form, and is composed of nearly flat, or scarcely convex, thin plates, joined together by slightly-channeled sutures, and without costæ, nodes, or other distinct markings. In some instances, these body-plates present the appearance of being a little beveled along their edges, and irregularly subimbricating; but this appearance may be deceptive. As already stated, we know nothing of its base, or of its subradial pieces, if it possessed the latter. If it was a free Crinoid, and at all related to *Marsupites*, it will probably be found, like that genus, to have a central piece, surrounded by basals, alternating with subradials, the latter also alternating with and supporting the radial series. It may, however, be as widely distinct from *Marsupites* in the structure of the basal parts of its body as in those above.

Our specimen, represented by the foregoing cut, Fig. B, shows two of the rays, with their divisions, one of the interradial fields with parts of two others, and two of the interaxillary spaces. Each of the two rays thus seen, at least as far down as they can be traced, has three primary radial pieces, the lowest one in each ray being wider than long and more or less nearly hexagonal in outline; while the second is narrower and hexagonal or pentagonal, the third again larger and hexagonal, and bears on each of its superior sloping sides, in direct succession, two large secondary radials. On the second of the latter, a kind of false bifurcation takes place: that is, there is given off here on the interradial side, a large arm-like series of pieces, the second of which is largest, while the others above diminish rapidly in size upward. This arm-like series, however, does not form a proper arm, or become free at all, excepting perhaps at its attenuated upper extremity, but connects laterally over the interradial field with the corresponding series from the next ray, so as completely to isolate the interradial pieces, and to unite with each other and with the divisions of the rays on each side, to form a part of the walls of the body.

Going back to the second of the secondary radials from which each of the lower arm-like series mentioned above is given off, we find that the main division of each ray is continued almost directly onward from

its other slightly-sloping upper side, first by two large plates in direct succession, the upper one of which is larger than the other, wider than long, generally hexagonal in form, and gives off on the interaxillary side another arm-like series of pieces, which pieces diminish rapidly in size upward, and connect with a corresponding series from the other division of the ray over the interaxillary space, so as to isolate the interaxillary pieces. At least, a few of the lower pieces of these little arm-like series over the interaxillary spaces are fastened together and to the adjacent parts, to form portions of the walls of the body. The next piece of the main division of each ray, above that last mentioned, also gives off, on the interradial side, another arm-like series of pieces, some of the lower of which are fastened to those of the larger series first described. Above this, the main divisions of the rays soon become free arms, composed of much shorter, transversely-oblong, or slightly wedge-shaped pieces, apparently every second one of which gives off alternately, on opposite sides, short, free pinnules. Soon the arms become rounded, on the outer or dorsal side, with a deep ambulacral furrow within; while beyond they very gradually taper and extend to great lengths, apparently without bifurcating. In all cases, they and the intermediate arm-like divisions draw together rapidly at the upper part of the body before becoming free, and thus seem to reduce the vault or ventral area to comparatively small dimensions.

The specimen represented by Fig. B shows one of the interradial areas (or possibly it may be the anal) to be rather large, and occupied by nine unequal plates, the lower one of which is wider than high, hexagonal in form, and supports two nearly as large heptagonal pieces in the next range, while those above are of various forms and sizes, and more or less irregularly arranged. Mr. Grinnell's Fig. 1 also shows about the same number of pieces in one of these areas, but they are somewhat differently arranged.

Of the interaxillary spaces, our specimens show only two in one specimen, and one in another, and each of these is occupied by only two interaxillary pieces, generally of heptagonal form, and placed directly one above the other. In order that the interradial and interaxillary series of plates may be the more readily distinguished from those belonging to the radial system, I have had a light shade drawn over the former in figure B, and a dotted line run up each of the rays and its subdivisions.

None of our specimens retain the arms much above the summit of the body; but Mr. Grinnell says that in some of those studied by him they can be traced to a length of eight inches, and yet have the ends broken off, so that he thinks they may have attained a length of not less than one foot. One of his figured specimens shows a large number of long, slender, jointed pieces that seem to be portions of slender, detached, simple arms, bearing short pinnules, apparently in some cases springing one from each joint. As much as the small interradial arm-like divisions of the rays look like a series of smaller arms springing from the summit of the interradial pieces, it is evident that they are really parts of the radial system, or, in other words, divisions given off from the secondary radials; and the same may be said of those seen in the interaxillary spaces. In fact, they all correspond to the pinnules of the free rays or arms in all respects, excepting that they are larger, and united with each other and with the main divisions of the rays for some distance up, so as to constitute a part of the walls of the body.

Some of the characters mentioned in these remarks are generic and some merely specific, as we have not yet the means of giving separate generic and specific diagnoses from such specimens as have been found.

The most important points yet to be determined are the nature of the base (whether composed of five pieces surrounding a central piece, and whether or not it was connected with a column), the presence or absence of subradial pieces, and whether there is an anal series of pieces differing from each of interradial series.

That this Crinoid belongs to a new genus, however, there can scarcely be any doubt. At least, even if agreeing with *Marsupites* in the nature of its base, subradial pieces, and the absence of any column, it would still differ very widely from that genus in the possession of interradial and interaxillary pieces, as well as in the several divisions of its radial series before becoming free, and the consequent greater number and different arrangement of the pieces composing its entire body.

Specimens flattened sidewise, with the arms broken off above the body, like that represented by Fig. B, at a first glance strike one as being very similar to certain forms of the Palæozoic genus *Forbesiocrinus*, such, for instance, as *F. Wortheni* from the Carboniferous rocks. There is no probability, however, of there being any near relations between these types.

As this is the only Crinoid yet found in our Cretaceous rocks, and presents some rather remarkable features, palæontologists will await with some interest the discovery of specimens in a condition to show all of its structure.

Our specimens were sent by Professor Mudge of Manhattan, Kans., from the Niobrara group of the Upper Missouri Cretaceous series, in Trigo County, Kansas; and I believe the Kansas specimens figured by Mr. Grinnell came from the same place. They certainly came at least from the same horizon. The specimen first discovered by Professor Marsh in Utah, was found associated with *Ostrea congesta*, Conrad, a species unknown from any other horizon than the Niobrara and Benton groups; thus showing, as might be expected from the invariably restricted geological range of the species of the *Crinoidea*, that the specimens at these two widely-separated localities occupy about the same geological horizon.

GENERAL INDEX.

SYSTEMATIC INDEX.